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Vibration-Rotation Bands of HF and DF

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Interim Report

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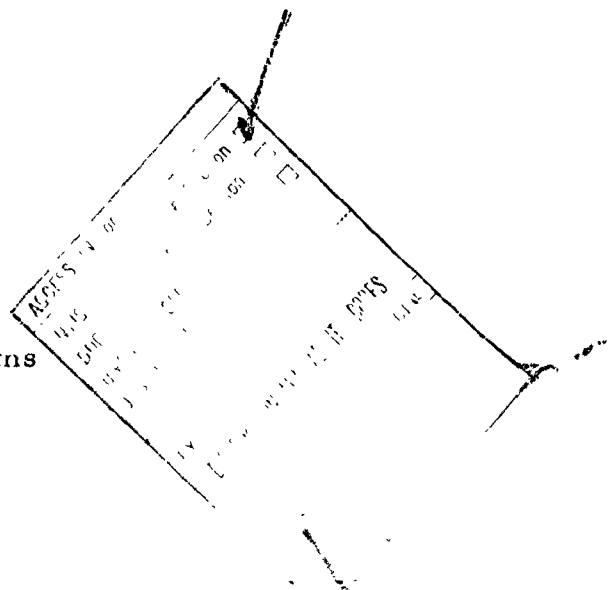
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20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

Calculations have been made for HF of the rotational lines for both the P- and R-branches in 45 $(v \rightarrow v - \Delta v)$ bands with $v = \Delta v$ to $v = 9$, and for DF of the rotational lines for both P- and R-branches in 78 $(v \rightarrow v - \Delta v)$ bands with $v = \Delta v$ to $v = 12$. The line positions for the P-branch and R-branch are listed for each Δv sequence for values of J from 0 to 50. The rotational constants for DF were calculated from isotopic relations by means of the Dunham coefficients for HF published by Mann et al. Band centers, vibrational-energy and rotational-energy-term values are presented for both HF and DF.

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PREFACE

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CONTENTS

TABLES

TABLES (Continued)

I. INTRODUCTION

Recent theoretical kinetic studies on v → R energy-transfer processes in the HF and DF systems required rotation-vibration energy terms and band centers for both HF and DF. Previous spectroscopic tables calculated in this laboratory terminated at J = 30, and an incomplete set of Dunham coefficients[1] was used for DF, which was obtained from the work of Talley, Kaylor, and Nielsen[2] published in 1950. Their work was done on the v → R bands of DF when the technique of measurements was in a somewhat uncertain state.[3] A more complete set of Dunham coefficients was calculated by Mann et al.[4] for HF in 1961 from a rotation-vibration analysis carried out on measured hydrogen-fluoride vibration-rotation emission spectrum obtained from a hydrogen-fluoride diffusion flame.

A complete set of Dunham coefficients for HF that were slightly different from those of Mann et al.[4] were calculated by Webb and Rao[5] in 1968 from their measurements of the high J rotational structure of the 1 → 0 and 2 → 0 bands of heated HF. Since the Dunham coefficients provided by Webb and Rao[5] did not agree very well with all of the P- and R-branch line positions of HF provided by Mann et al.,[4] we decided that the Dunham coefficients provided by Mann et al.[4] were better since they are in excellent agreement with all available measurements, including those of Webb and Rao.[5] The Dunham coefficients for DF were calculated from those of HF provided by Mann et al.[4]

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[1] J. L. Dunham, Phys. Rev. 41, 721 (1932).

[2] R. M. Talley, H. M. Kaylor, and A. H. Neilsen, Phys. Rev. 77, 529 (1950).

[3] R. N. Spanbauer and K. Narahari Rao, J. Molecular Spectroscopy, 16, 100 (1965).

[4] D. E. Mann, R. A. Thrush, D. R. Like, Jr., J. J. Ball, and N. Acquista, J. Chem. Phys. 34, 420 (1961).

[5] D. U. Webb and K. Narahari Rao, J. Molecular Spectroscopy, 28, 121 (1968).

by means of isotope relationships.[1] For HF, the rotational lines were calculated for both the P- and R-branches in 45 ($v \rightarrow v - \Delta v$) bands with $v = \Delta v$ to $v = 9$, and, for DF, the rotational lines were calculated for both the P- and R-branches in 78 ($v \rightarrow v - \Delta v$) bands with $v = \Delta v$ to $v = 12$. Rotational constants, band centers, vibrational energy terms, and rotation-vibration energy terms were calculated for HF and DF.

II. METHOD OF COMPUTATION

The rotational constants B_v, D_v, and H_v and the vibrational energy terms $G(v)$ are expressed as power series in $(v + 1/2)$. In the notation of Dunham,

$$B_v = \sum_{k=0}^{k=4} \rho^{2+k} Y_{k1}\left(v + \frac{1}{2}\right)^k \tag{1}$$

$$D_v = \sum_{k=0}^{k=2} \rho^{4+k} Y_{k2}\left(v + \frac{1}{2}\right)^k \tag{2}$$

$$H_v = \sum_{k=0}^{k=1} \rho^{6+k} Y_{k3}\left(v + \frac{1}{2}\right)^k \tag{3}$$

and

$$G(v) = \sum_{k=1}^{k=5} \rho^{k} Y_{k0}\left(v + \frac{1}{2}\right)^k \tag{4}$$

where Y_{jk} are the Dunham coefficients and $\rho = \mu/\mu^i$ (where μ is the reduced mass of the ordinary diatomic molecule and μ^i is the reduced mass of its isotopic molecule). With $\rho = 1$ and 0.72494822, and with the use of Dunham coefficients for HF (Table 1), the rotational constants B_v, D_v, and H_v and the vibrational energy terms $G(v)$ tabulated in Tables 2 and 3 for HF and DF, respectively, were calculated. The rotation-vibration energy terms are expressed as a double expansion in $J(J + 1)$ and $(v + 1/2)$

$$E_{v,J} = \sum_{j=1}^{j=4} \sum_{k=0}^{k=5} Y_{kj}\left(v + \frac{1}{2}\right)^k \left[J(J + 1)\right]^j \tag{5}$$

The rotation-vibration energy terms were calculated for HF for $v = 0$ to $v = 9$ with $J = 0$ through $J = 50$, and for DF for $v = 0$ to $v = 12$ with $J = 0$ through $J = 50$ by means of the Dunham coefficients given in Table 1. The rotation-vibration energy terms of HF and DF are listed in Tables 4 and 5, respectively. The positions of the band centers or the v' to v lines of a diatomic molecule are given by

$$\omega_c(v', v) = G(v') - G(v) \tag{6}$$

The 45 band centers for HF are listed in Table 6, and the 78 band centers for DF are listed in Table 7. The positions of the (v', J') to (v, J) lines of a diatomic molecule are given by

$$\omega_c(v, J, m) = G(v') - G(v) + E(v', J + m) - E(v, J) \tag{7}$$

where $m = -1$ for the P-branch and $+1$ for the R-branch. P-branch and R-branch line positions were calculated and are tabulated in Tables 8 and 9 for HF, and in Tables 10 and 11 for DF.

In Tables 12 through 16, the calculated line positions for HF and DF are compared with available experimental data.[4-7] The P-branch and R-branch line position values are in excellent agreement with HF and DF wavelength measurements.

[6] T. F. Deutsch, Appl. Phys. Lett., 10, 234 (1967).

[7] D. J. Spencer, G. C. Denault, and H. H. Takimoto, Atmospheric Gas Absorption DF Laser Wavelengths, TR-0074(4240-10)-7, The Aerospace Corporation (January 1974).

Table 1. Dunham Coefficients[a]

Coefficient	Approximate Identification	HF[b]	DF
Y_{10}	ω_e	4138.73	3000.36
Y_{20}	$-\omega_e x_e$	-90.05	-47.33
Y_{30}	$\omega_e y_e$	0.932	0.355
Y_{40}	$\omega_e z_e$	-1.42×10^{-2}	-0.392×10^{-2}
Y_{50}		-5.9×10^{-4}	-1.181×10^{-4}
Y_{01}	B_e	20.9555	11.0132
Y_{11}	$-\alpha_e$	-0.7958	-0.3032
Y_{21}	γ_e	1.182×10^{-2}	0.326×10^{-2}
Y_{31}		-3.11×10^{-4}	-0.623×10^{-4}
Y_{41}		-5.8×10^{-6}	-0.842×10^{-6}
Y_{02}	$-D_e$	-2.153×10^{-3}	-0.5947×10^{-3}
Y_{12}	β_e	6.23×10^{-5}	1.25×10^{-5}
Y_{22}		-2.06×10^{-6}	-0.299×10^{-6}
Y_{03}	H_e	1.68×10^{-7}	0.244×10^{-7}
Y_{13}		-6.5×10^{-9}	-0.684×10^{-9}
Y_{04}		-1.9×10^{-11}	-0.145×10^{-11}

[a] In units of cm^{-1}.

[b] D. E. Mann, B. A. Thrush, D. R. Lide, Jr., J. J. Ball, and N. Acquista, J. Chem. Phys. 34, 420 (1961).

Table 2. Molecular Constants of the HF Molecule

v	B_v, cm^{-1}	$D_v \times 10^3$, cm^{-1}	$H_v \times 10^7$, cm^{-1}	$G(v)$, cm^{-1}
0	20.561	2.122	1.648	2046.968
1	19.787	2.064	1.583	6008.552
2	19.035	2.010	1.518	9797.963
3	18.301	1.960	1.453	13419.961
4	17.583	1.914	1.388	16878.789
5	16.879	1.873	1.323	20178.101
6	16.186	1.835	1.258	23320.889
7	15.502	1.802	1.193	26309.419
8	14.824	1.772	1.128	29145.153
9	14.148	1.747	1.063	31828.683

Table 3. Molecular Constants of the DF Molecule

v	B_v, cm^{-1}	$D_v \times 10^4$, cm^{-1}	$H_v \times 10^8$, cm^{-1}	$G(v)$, cm^{-1}
0	10.862	5 885	2.405	1488.395
1	10.566	5.766	2.336	4395.242
2	10.274	5.654	2.268	7210.510
3	9.989	5.547	2.199	9936.110
4	9.709	5.446	2.131	12573.827
5	9.433	5.351	2.063	15125.297
6	9.162	5.262	1.994	17592.003
7	8.894	5.179	1.926	19975.252
8	8.629	5.102	1.857	22276.169
9	8.367	5.031	1.789	24495.674
10	8.107	4.967	1.720	26634.475
11	7.849	4.908	1.652	28693.050
12	7.591	4.855	1.584	30671.636

Table 4.   Rotation-Vibration Energy of HF Molecule

E(V,J) , 1/CM

CALC.

V	J=0	J=1	J=2	J=3	J=4	J=5	J=6
0	0.00	41.11	123.29	246.42	410.36	614.91	859.81
1	0.00	39.57	118.65	237.15	394.92	591.77	827.44
2	0.00	38.06	114.14	228.13	379.89	569.24	795.93
3	0.00	36.59	109.73	219.07	365.23	547.29	765.19
4	0.00	35.16	105.43	210.72	350.28	525.89	735.12
5	0.00	33.75	101.21	202.28	336.80	504.69	705.60
6	0.00	32.37	97.20	193.97	323.03	483.94	676.60
7	0.00	31.00	92.95	185.77	309.37	463.45	647.93
8	0.00	29.64	88.88	177.63	295.77	443.13	619.49
9	0.00	28.29	84.83	169.53	282.27	422.88	591.15

V	J=7	J=8	J=9	J=10	J=11	J=12	J=13
0	1144.76	1469.42	1833.37	2236.19	2677.38	3156.40	3672.69
1	1101.64	1414.04	1764.25	2151.84	2576.32	3037.18	3533.85
2	1059.67	1360.14	1696.96	2069.70	2477.91	2921.07	3398.64
3	1018.67	1307.55	1631.30	1989.56	2381.88	2807.76	3266.52
4	978.67	1256.11	1567.30	1911.15	2287.92	2696.88	3137.52
5	939.38	1205.64	1504.05	1834.22	2195.92	2588.06	3010.76
6	900.71	1156.07	1442.01	1758.44	2105.18	2480.96	2885.88
7	862.50	1106.87	1380.70	1683.61	2015.18	2374.96	2762.44
8	826.04	1058.18	1319.88	1609.93	1926.13	2269.82	2639.91
9	786.84	1009.66	1259.27	1535.31	1837.37	2165.01	2517.74

V	J=14	J=15	J=16	J=17	J=18	J=19	J=20
0	4225.90	4814.49	5438.65	6097.36	6789.79	7515.17	8272.65
1	4065.93	4632.16	5231.70	5860.01	6550.70	7229.40	7955.68
2	3910.03	4454.23	5031.70	5640.61	6280.60	6950.89	7650.68
3	3758.03	4281.23	4835.61	5420.49	6030.60	6678.82	7356.73
4	3609.22	4111.88	4643.64	5205.49	5794.76	6412.34	7056.87
5	3463.25	3944.88	4455.13	4993.28	5558.89	6150.51	6768.09
6	3319.35	3780.72	4269.37	4784.66	5325.89	5892.36	6483.32
7	3177.87	3637.15	4089.64	4578.66	5090.58	5636.87	6201.18
8	3035.04	3457.15	3903.15	4373.24	4846.50	5382.96	5921.18
9	2895.04	3296.36	3721.11	4168.66	4638.35	5129.50	5641.37

V	J=21	J=22	J=23	J=24	J=25	J=26	J=27
0	9061.33	9880.32	10728.66	11605.38	12509.49	13439.95	14395.72
1	8715.89	9503.13	10318.49	11161.30	12029.71	12923.59	13841.63
2	8379.10	9135.38	9918.47	10767.72	11603.83	12419.80	13300.80
3	8050.10	8775.60	9527.43	10303.72	11103.83	11926.80	12771.63
4	7727.61	8423.60	9144.09	9888.16	10654.87	11443.27	12252.39
5	7410.98	8077.25	8767.14	9479.93	10213.14	10967.43	11741.25
6	7097.98	7737.53	8395.14	9075.93	9774.00	10497.43	11236.38
7	6788.42	7397.10	8026.61	8676.10	9344.68	10034.42	10736.47
8	6480.62	7060.50	7659.10	8278.51	8914.33	9567.40	10236.47
9	6173.21	6724.23	7293.61	7880.51	8484.03	9103.27	9737.28

Table 4. Rotation-Vibration Energy of HF Molecule (Continued)

$E(V,J)$, 1/CM

CALC.

V=	J= 28	J= 29	J= 30	J= 31	J= 32	J= 33	J= 34
0	15375.72	16378.83	17403.95	18449.92	19515.56	20599.68	21701.06
1	14782.76	15745.91	16729.97	17733.81	18756.28	19796.21	20852.39
2	14203.87	15127.85	16071.64	17034.16	18014.25	19010.75	20022.48
3	13637.23	14522.74	15426.88	16349.35	17287.67	18241.07	19208.60
4	13063.65	13928.60	14783.88	15675.95	16572.17	17484.87	18407.01
5	12553.60	13343.60	14170.06	15011.95	15868.17	16737.58	17619.01
6	11955.58	12765.14	13553.15	14355.14	15170.96	15998.53	16837.00
7	11455.58	12191.01	12940.64	13703.40	14478.17	15263.89	16059.33
8	10920.59	11618.73	12329.88	13052.96	13736.87	14530.49	15282.64
9	10385.10	11045.72	11718.10	12401.18	13093.85	13794.97	14503.37

V=	J= 35	J= 36	J= 37	J= 38	J= 39	J= 40	J= 41
0	22818.46	23950.59	25096.18	26253.88	27422.35	28600.19	29785.98
1	21923.45	23027.56	24106.01	25214.63	26333.07	27459.95	28593.86
2	21040.23	22086.30	23135.75	24196.96	25262.07	26342.54	27426.07
3	20130.67	21182.30	22135.41	23197.70	24217.80	25244.43	26276.78
4	19251.29	20199.17	21135.76	22210.67	23184.97	24161.88	25142.78
5	18511.85	19413.85	20248.40	21224.03	22163.64	23090.91	24022.53
6	17685.18	18541.85	19405.73	20275.51	21149.85	22027.34	22906.53
7	16804.22	17607.69	18491.94	19313.89	20139.38	20966.71	21798.13
8	16042.12	16807.69	17578.05	18351.89	19127.81	19904.39	20680.13
9	15217.83	15937.10	16659.87	17384.80	18110.49	18835.47	19558.25

V=	J= 42	J= 43	J= 44	J= 45	J= 46	J= 47	J= 48
0	30978.24	32175.48	33376.13	34578.59	35781.18	36982.16	38179.74
1	29737.89	30876.83	32022.83	33169.97	34315.78	35459.30	36598.99
2	28511.29	29602.54	30696.41	31785.92	32875.82	34485.75	35042.62
3	27311.26	28348.57	29386.35	30427.85	31453.66	32485.75	33589.02
4	26126.18	27110.70	28094.59	29075.74	30053.69	31025.06	31989.06
5	24960.92	25883.98	26813.97	27709.74	28660.69	29574.59	30473.68
6	23785.92	24663.36	25538.97	26409.89	27274.07	28128.56	28994.52
7	22621.49	23444.36	24265.15	25078.89	25889.53	26680.86	27465.17
8	21472.49	22222.84	22986.50	23742.68	24489.53	25225.10	25947.32
9	20277.23	20990.76	21697.11	22394.48	23080.96	23754.54	24413.12

V=	J= 49	J= 50
0	39372.03	40557.05
1	37731.03	38858.93
2	36116.54	37180.99
3	34522.47	35525.88
4	32943.45	33885.23
5	31313.45	32254.50
6	29806.39	30624.39
7	28280.81	28989.81
8	26654.57	27342.91
9	25054.46	25676.20

Table 5. Rotation-Vibration Energy of DF Molecule

E(V,J) , 1/CM

CALC.

J=	0	1	2	3	4	5	6
V= 0	0.000	21.72	65.15	130.26	217.01	325.34	455.18
1	0.000	21.13	63.37	126.70	211.08	316.45	442.74
2	0.000	20.55	61.63	123.21	205.27	307.73	430.54
3	0.000	19.98	59.92	119.79	199.56	299.18	418.57
4	0.000	19.42	58.23	116.43	193.96	290.78	406.81
5	0.000	18.86	56.58	113.12	188.45	282.52	395.25
6	0.000	18.32	54.95	109.86	183.02	274.38	383.87
7	0.000	17.79	53.35	106.65	177.67	266.35	372.63
8	0.000	17.26	51.76	103.48	172.38	258.42	361.53
9	0.000	16.73	50.18	100.33	167.14	250.56	350.54
10	0.000	16.21	48.63	97.21	161.95	242.77	339.63
11	0.000	15.70	47.07	94.11	156.78	235.02	328.78
12	0.00	15.18	45.53	91.02	151.63	227.30	317.97

J=	7	8	9	10	11	12	13
V= 0	606.45	779.05	972.86	1187.77	1423.63	1680.30	1957.60
1	589.86	757.74	946.24	1155.26	1384.65	1634.27	1903.96
2	573.61	736.85	920.15	1123.39	1346.44	1589.16	1851.38
3	557.66	716.35	894.55	1092.13	1308.96	1544.89	1799.70
4	541.99	696.22	869.40	1061.41	1272.13	1501.41	1749.10
5	526.58	676.42	844.67	1031.24	1235.91	1458.64	1699.24
6	511.41	656.92	820.31	1001.45	1200.22	1416.50	1650.15
7	496.44	637.68	796.27	972.09	1165.01	1374.91	1601.73
8	481.69	618.67	772.51	943.07	1130.24	1333.81	1553.27
9	466.99	599.84	748.98	914.33	1095.74	1293.10	1506.27
10	452.45	581.15	725.64	885.81	1061.52	1252.70	1459.16
11	437.37	562.57	702.42	857.44	1027.52	1212.46	1412.31
12	423.58	544.05	679.28	829.17	993.61	1172.46	1365.60

J=	14	15	16	17	18	19	20
V= 0	2255.36	2573.40	2911.50	3269.46	3647.04	4044.01	4460.12
1	2193.54	2502.82	2831.62	3179.71	3546.87	3932.88	4337.48
2	2132.93	2433.64	2753.30	3091.72	3449.66	3823.97	4217.23
3	2073.47	2365.75	2676.94	3005.32	3357.57	3716.87	4099.19
4	2015.06	2299.05	2600.65	2920.52	3257.37	3608.45	3983.04
5	1957.56	2233.43	2526.65	2837.07	3164.53	3508.53	3869.04
6	1900.94	2168.77	2453.20	2754.57	3072.88	3406.92	3756.53
7	1845.05	2104.96	2381.20	2673.57	2981.24	3306.42	3645.40
8	1789.80	2041.88	2309.77	2593.29	2892.24	3206.42	3535.60
9	1735.08	1979.36	2239.05	2513.75	2803.42	3009.94	3426.74
10	1680.87	1917.36	2168.87	2434.22	2715.24	2912.53	3318.65
11	1626.74	1855.65	2098.87	2356.22	2627.50	2815.37	3211.97
12	1572.87	1794.12	2029.18	2277.87	2540.00	—	3103.77

Table 5.   Rotation-Vibration Energy of DF Molecule (Continued)

E(V,J) , 1/CM

CALC.

V=	J= 21	22	23	24	25	26	27
0	4895.11	5348.70	5820.62	6310.57	6818.24	7343.33	7885.52
1	4760.42	5201.22	5660.25	6136.57	6630.11	7140.35	7667.57
2	4628.35	5057.26	5502.98	5965.93	6445.58	6941.63	7453.78
3	4497.11	4915.92	5348.58	5798.38	6264.27	6746.11	7243.39
4	4371.29	4775.92	5196.82	5633.55	6086.27	6554.19	7037.39
5	4245.89	4638.58	5047.42	5471.55	5910.91	6365.19	6834.11
6	4121.26	4507.80	4900.72	5311.85	5738.26	6194.58	6635.61
7	4000.26	4380.10	4754.85	5153.87	5567.03	5994.58	6439.63
8	3879.56	4267.09	4610.85	4997.67	5398.26	5812.34	6239.28
9	3759.15	4107.22	4468.25	4842.85	5230.74	5631.61	6045.15
10	3641.22	3979.22	4326.61	4689.06	5064.20	5461.32	5859.81
11	3522.92	3847.85	4185.61	4535.94	4898.60	5273.32	5667.81
12	3404.98	3718.77	4044.91	4383.15	4733.22	5094.87	5467.81

V=	J= 28	29	30	31	32	33	34
0	8444.46	9019.83	9611.29	10218.42	10840.96	11478.39	12130.46
1	8210.87	8770.06	9344.89	9934.97	10534.44	11159.28	11792.84
2	7981.11	8525.06	9083.53	9656.49	10244.44	10846.20	11461.80
3	7756.31	8284.72	8826.09	9383.69	9954.37	10538.58	11135.37
4	7535.60	8047.72	8574.58	9114.69	9668.54	10235.58	10815.37
5	7317.36	7814.70	8325.22	8848.65	9387.24	9937.87	10499.61
6	7102.82	7585.63	8080.77	8588.46	9109.65	9642.87	10187.61
7	6890.82	7357.63	7839.61	8330.46	8835.24	9351.60	9874.82
8	6681.35	7132.90	7597.73	8074.18	8563.93	9063.60	9574.68
9	6471.80	6907.85	7359.61	7821.18	8293.93	8777.55	9271.68
10	6264.80	6687.98	7122.90	7569.00	8029.64	8493.06	8970.36
11	6057.80	6466.44	6887.06	7317.72	7758.64	8209.50	8669.95
12	5851.76	6246.44	6651.53	7066.74	7491.73	7926.19	8369.77

V=	J= 35	36	37	38	39	40	41
0	12796.73	13476.81	14170.29	14876.77	15595.82	16327.03	17069.96
1	12444.15	13101.82	13774.66	14460.66	15159.00	15869.08	16590.47
2	12090.15	12731.70	13385.81	14052.60	14730.01	15419.27	16119.44
3	11746.56	12368.88	13002.75	13651.11	14308.75	14976.93	15656.16
4	11407.92	12011.72	12627.67	13254.82	13892.84	14541.33	15199.88
5	11073.92	11659.82	12256.94	12864.90	13483.29	14111.74	14749.82
6	10744.57	11312.64	11890.81	12479.90	13078.29	13687.42	14305.17
7	10418.27	10968.18	11528.89	12093.79	12678.56	13267.04	13865.06
8	10096.27	10628.18	11169.99	11721.33	12281.68	12851.34	13428.62
9	9777.80	10290.09	10813.09	11346.33	11887.68	12437.34	12994.92
10	9457.36	9953.73	10459.09	10973.68	11495.34	12025.43	12563.08
11	9139.66	9618.27	10105.41	10600.73	11103.86	11614.36	12131.88
12	8822.14	9282.94	9751.81	10228.39	10712.30	11203.14	11700.53

Table 5. Rotation-Vibration Energy of DF Molecule (Continued)

E(V,J) , 1/CM

CALC.

V=	J= 42	43	44	45	46	47	48
0	17824.18	18589.24	19364.70	20150.09	20944.96	21748.84	22561.25
1	17322.73	18065.44	18818.14	19580.39	20351.72	21131.69	21919.80
2	16830.04	17554.74	18281.00	19020.42	19768.54	20524.90	21289.03
3	16346.44	17044.36	17752.48	18469.35	19194.52	19927.54	20667.95
4	15868.07	16545.49	17231.69	17926.25	18628.72	19338.64	20055.56
5	15391.77	16053.77	16717.76	17390.22	18070.16	18757.16	19450.76
6	14931.09	15566.08	16209.73	16860.22	17517.81	18182.04	18852.47
7	14471.09	15085.08	15706.62	16335.28	16970.611	17612.17	18259.50
8	14014.16	14607.23	15207.43	15814.31	16427.44	17046.37	17670.65
9	13560.01	14132.20	14711.08	15296.20	15887.14	16483.44	17084.66
10	13107.65	13658.94	14216.47	14779.81	15348.51	15922.14	16500.98
11	12656.007	13186.36	13722.48	14263.94	14810.31	15361.15	15909.98
12	12204.07	12713.33	13227.91	13747.36	14271.25	14799.13	15330.53

V=	J= 49	50
0	23381.70	24209.72
1	22720.45	23518.570
2	22060.45	22838.70
3	21414.288	22168.048
4	20778.99	21608.488
5	20150.449	20855.01
6	19528.614	20210.62
7	18912.14	19569.385
8	18299.82	18933.95
9	17690.322	18299.95
10	17082.304	17667.90
11	16474.34	17035.76
12	15864.99	16402.01

Table 6.   Band Centers of HF Molecule[a]

v'	v = 0	v = 1	v = 2	v = 3	v = 4	v = 5	v = 6	v = 7	v = 8
1	3961.58								
2	7750.99	3789.41							
3	11372.99	7411.41	3622.00						
4	14831.82	10870.24	7080.83	3458.83					
5	18131.13	14169.55	10380.14	6758.14	3299.31				
6	21273.92	17312.34	13522.93	9900.93	6442.10	3142.79			
7	24262.45	20300.87	16511.46	12589.46	9430.63	6131.32	2988.53		
8	27098.19	23136.60	19347.19	15725.19	12266.36	8967.05	5824.26	2835.73	
9	29781.71	25820.13	22030.72	18408.72	14949.89	11650.58	8507.79	5519.26	2683.53

[a]In units of cm^{-1}.

Table 7. Band Centers of DF Molecule[a]

v'	v = 0	v = 1	v = 2	v = 3	v = 4	v = 5	v = 6	v = 7	v = 8	v = 9	v = 10	v = 11
1	2906.85											
2	5722.?1	2815.27										
3	8447.72	5540.87	2725.60									
4	11085.43	8178.58	5363.32	2637.72								
5	13636.90	10730.05	7914.79	5189.19	2551.47							
6	16103.61	13196.76	10381.49	7655.89	5018.18	2466.71						
7	18486.86	15580.01	12764.74	10039.14	7401.43	4349.96	2383.25					
8	20787.77	17880.93	15065.66	12340.06	9702.34	7150.87	4684.17	2300.92				
9	23007.28	20100.43	17285.16	14559.56	11921.85	9370.38	6903.67	4520.42	2219.50			
10	25146.08	22239.23	19423.96	16698.36	14060.65	11509.18	9042.47	6659.22	4358.31	2138.80		
11	27204.66	24297.81	21482.54	18756.94	16119.22	13567.75	11101.05	8717.80	6416.88	4197.38	2058.58	
12	29183.24	26276.39	23461.13	20735.53	18097.81	15546.34	13079.63	10696.38	8395.47	6175.96	4037.17	1978.59

[a]In units of cm^{-1}.

Table 8a. Line Positions for HF, P-Branch, Δv = 1 Sequence

$NU(V, J, -1)$, 1/CM , P-BRANCH , DELTA NU = 1

v	J=1	J=2	J=3	J=4	J=5	J=6	J=7
0	3920.47	3877.86	3833.81	3788.37	3741.60	3693.54	3644.26
1	3749.84	3708.82	3666.40	3622.62	3577.54	3531.21	3483.69
2	3572.94	3544.46	3503.60	3461.43	3417.99	3373.34	3327.51
3	3412.23	3384.63	3344.93	3304.20	3262.46	3219.41	3175.23
4	3192.64	3227.63	3189.80	3150.70	3110.37	3068.88	3026.27
5	3109.06	3073.95	3037.56	2999.90	2961.09	2921.10	2889.05
6	2956.06	2922.47	2887.51	2851.93	2813.05	2775.38	2735.72
7	2804.74	2772.43	2738.85	2704.04	2668.35	2630.93	2592.72
8	2653.89	2622.94	2590.72	2557.29	2522.67	2486.92	2450.08

v	J=8	J=9	J=10	J=11	J=12	J=13	J=14
0	3593.81	3542.25	3489.64	3436.04	3381.50	3326.08	3269.83
1	3405.04	3345.09	3334.59	3282.05	3230.15	3176.63	3122.84
2	3229.60	3160.34	3186.34	3133.10	3080.89	3031.04	2978.31
3	3031.88	2937.88	3036.34	2988.10	2938.45	2889.04	2838.31
4	2848.07	2750.58	2892.00	2845.61	2798.14	2749.85	2700.76
5	2695.40	2651.40	2750.58	2707.22	2652.82	2617.94	2562.62
6	2553.46	2373.21	2610.76	2567.22	2522.82	2447.61	2431.62
7	2412.20	2307.25	2472.00	2429.89	2386.91	2343.11	2298.54
8	2373.31	2121.41	2333.46	2292.71	2251.08	2208.63	2165.39

v	J=15	J=16	J=17	J=18	J=19	J=20	J=21
0	3212.83	3155.12	3096.76	3037.80	2978.31	2918.34	2857.93
1	3067.20	3011.50	2955.00	2898.12	2840.61	2782.62	2724.20
2	2925.43	2871.53	2817.00	2761.04	2706.26	2650.15	2593.66
3	2786.86	2734.55	2681.98	2628.64	2574.78	2520.44	2465.66
4	2651.01	2600.55	2549.18	2497.84	2445.17	2392.95	2335.89
5	2516.53	2468.38	2418.88	2368.74	2318.17	2267.06	2215.49
6	2384.14	2337.25	2289.62	2240.09	2191.50	2142.09	2090.99
7	2253.41	2207.25	2031.40	2113.35	2065.09	2017.85	1968.49
8	2121.41	2076.74		1985.45	1938.92	1891.85	1844.28

v	J=22	J=23	J=24	J=25	J=26	J=27	J=28
0	2797.60	2736.06	2676.69	2613.19	2551.34	2489.45	2427.49
1	2665.68	2606.28	2546.88	2487.25	2426.12	2367.40	2307.46
2	2536.50	2479.42	2421.88	2364.10	2306.12	2248.00	2189.76
3	2410.50	2355.42	2299.20	2243.15	2186.89	2130.46	2073.43
4	2282.22	2232.46	2176.57	2120.57	2069.18	2014.37	1959.30
5	2163.52	2111.18	2058.52	2005.57	1952.38	1898.97	1845.41
6	2041.49	1990.49	1939.21	1887.63	1835.78	1783.73	1731.41
7	1919.62	1869.62	1819.82	1769.28	1718.65	1667.75	1616.63
8	1796.24	1747.78	1699.70	1649.70	1600.16	1550.32	1500.23

Table 8a.   Line Positions for HF, P-Branch, Δv = 1 Sequence (Continued)

NU(V,J,-1) , 1/CM , P-BRANCH , DELTA NU = 1

V=	J= 29	30	31	32	33	34	35
0	2365.51	2303.54	2241.63	2179.84	2118.19	2056.73	1995.52
1	2247.37	2187.29	2127.25	2067.28	2007.45	1947.77	1888.30
2	2131.46	2073.14	2014.88	1956.58	1898.43	1840.41	1782.56
3	2017.27	1960.58	1903.88	1847.20	1790.61	1734.11	1677.75
4	1904.22	1849.03	1793.81	1738.59	1683.47	1628.29	1573.28
5	1791.69	1737.89	1684.99	1630.09	1576.17	1522.30	1468.50
6	1678.69	1626.39	1573.71	1520.97	1468.20	1415.42	1362.68
7	1565.30	1513.83	1462.22	1410.50	1358.71	1306.89	1255.05
8	1449.90	1399.37	1348.68	1297.84	1246.89	1195.86	1144.78

V=	J= 36	37	38	39	40	41	42
0	1934.58	1873.96	1813.71	1753.86	1694.46	1635.56	1577.20
1	1829.08	1770.15	1711.54	1653.30	1595.47	1538.09	1481.78
2	1724.93	1667.56	1610.45	1553.46	1497.29	1441.31	1385.78
3	1621.57	1565.72	1509.89	1454.01	1399.37	1344.64	1290.32
4	1518.02	1463.24	1407.85	1355.01	1301.07	1247.45	1194.71
5	1414.80	1361.24	1306.25	1254.67	1201.57	1149.06	1096.12
6	1310.80	1257.42	1204.96	1152.67	1100.57	1048.71	997.12
7	1203.24	1152.48	1099.80	1048.24	996.83	945.61	894.60
8	1093.67	1047.57	991.51	940.52	889.63	838.87	788.29

V=	J= 43	44	45	46	47	48	49
0	1519.42	1462.28	1405.83	1356.11	1295.20	1241.07	1188.01
1	1424.04	1368.12	1314.01	1256.60	1205.03	1153.07	1101.08
2	1330.45	1276.25	1222.36	1169.02	1116.55	1064.75	1013.78
3	1236.25	1183.08	1130.25	1085.02	1026.44	975.84	925.47
4	1141.35	1088.95	1037.00	985.08	934.30	884.82	835.47
5	1044.73	993.15	942.00	891.08	841.37	791.82	743.02
6	945.84	894.97	844.34	793.65	744.74	695.61	647.49
7	843.86	793.43	743.34	693.65	644.67	595.66	547.49
8	737.91	687.79	637.96	588.48	539.39	490.75	442.63

V=	J= 50
0	1135.86
1	1050.60
2	976.21
3	786.21
4	694.94
5	599.55
6	490.55
7	395.08

Table 8b. Line Positions of HF, P-Branch, $\Delta v = 2$ Sequence

NU(V,J,-1) , 1/CM , P-BRANCH , DELTA NU = 2

v=	J= 1	2	3	4	5	6	7
0	7709.88	7665.77	7618.74	7568.82	7515.98	7460.42	7402.95
1	7371.84	7329.35	7283.99	7235.82	7184.88	7131.24	7070.28
2	7042.75	7003.85	6958.13	6911.65	6862.48	6810.67	6756.05
3	6724.55	6682.04	6640.02	6595.19	6547.71	6497.92	6440.03
4	6406.99	6369.04	6328.43	6285.18	6239.35	6190.92	6139.87
5	6091.57	6061.85	6019.17	5978.90	5935.95	5889.49	5839.04
6	5780.24	5761.85	5719.17	5678.90	5636.95	5590.49	5554.87
7	5488.27	5454.60	5418.32	5379.46	5338.08	5294.21	5247.92

v=	J= 8	9	10	11	12	13	14
0	7341.25	7277.76	7211.76	7143.32	7072.50	6999.38	6924.04
1	7016.09	6954.71	6890.87	6824.65	6756.12	6685.32	6612.34
2	6389.07	6639.40	6578.19	6514.07	6447.09	6379.07	6308.32
3	6686.70	6630.48	6578.63	6510.48	6446.09	6379.53	6010.85
4	5788.01	6030.44	5972.95	5912.65	5850.14	5785.47	5718.72
5	5788.14	5734.14	5677.80	5619.22	5558.44	5495.53	5430.55
6	5199.24	5148.22	5094.92	5039.39	4981.67	4921.88	4859.90
7							

v=	J= 15	16	17	18	19	20	21
0	6846.53	6766.94	6685.35	6601.81	6516.42	6429.24	6340.34
1	6537.60	6660.12	6403.02	6305.27	6217.12	6132.55	6046.24
2	6235.03	6160.18	6083.86	6005.207	5924.72	5842.92	5758.20
3	5740.34	5869.18	5792.77	5716.20	5637.97	5557.92	5476.85
4	5363.42	5294.56	5266.07	5141.93	5150.93	5200.10	5197.85
5	5079.24	5012.05	5223.67	5150.93	5076.39	5200.42	4922.17
6	4295.38	4729.99	4942.76	4871.28	4798.64	4723.91	4647.47
7			4662.11	4592.35	4520.74	4447.35	4372.22

v=	J= 22	23	24	25	26	27	28
0	6249.80	6157.69	6064.08	5969.05	5872.66	5774.98	5676.08
1	5958.04	5868.82	5777.83	5685.05	5591.65	5496.59	5400.29
2	5672.86	5580.96	5497.38	5407.42	5315.49	5223.92	5129.07
3	5402.86	5807.96	5221.56	5131.71	5637.71	5053.14	4862.07
4	5116.49	5033.54	4863.08	4863.16	5044.48	4687.50	4597.13
5	4781.62	4761.28	4678.32	4594.28	4775.83	4508.59	4333.05
6	4569.36	4489.62	4408.32	4325.49	4241.87	4155.41	4060.47
7	4295.38	4216.88	4136.78	4055.09	3971.87	3887.15	3800.97

v=	J= 29	30	31	32	33	34	35
0	5576.03	5474.89	5372.72	5269.59	5165.56	5060.68	4955.02
1	5302.110	5202.33	5104.50	5003.95	4902.38	4799.91	4696.61
2	5034.06	4937.95	4840.55	4742.91	4642.75	4542.42	4441.48
3	4765.86	4671.63	4519.69	4482.94	4305.42	4286.92	4187.48
4	4505.29	4413.36	4319.69	4224.89	4128.94	4032.03	3934.06
5	4243.72	4154.13	4065.01	3966.55	3871.94	3776.20	3679.30
6	3979.71	3889.85	3798.60	3706.26	3612.61	3517.75	3421.72
7	3712.36	3624.35	3533.97	3442.25	3349.22	3254.90	3159.31

Table 8b. Line Positions of HF, P-Branch, Δv = 2 Sequence (Continued)

NU(V,J-1) , 1/CM , P-BRANCH , DELTA NU = 2

V	J= 36	37	38	39	40	41	42
0	4848.63	4741.56	4633.87	4525.60	4416.81	4307.55	4197.87
1	4592.53	4487.70	4382.19	4276.04	4169.29	4061.05	3954.16
2	4339.13	4236.26	4132.63	4028.28	3923.25	3817.59	3711.31
3	4087.07	3985.90	3884.36	3780.64	3677.357	3572.99	3467.92
4	3835.07	3735.19	3634.36	3571.64	3430.307	3326.66	3222.45
5	3581.54	3482.53	3382.59	3026.31	3179.079	3076.97	2973.23
6	3324.54	3226.22	3126.81	2764.68	2924.74	2822.12	2718.47
7	3062.48	2964.4	2865.15		2663.04	2560.22	2456.25

V	J= 43	44	45	46	47	48	49
0	4087.80	3977.40	3866.72	3755.78	3644.65	3533.36	3421.96
1	3845.87	3737.14	3628.02	3518.55	3408.77	3298.70	3188.40
2	3604.47	3497.109	3387.201	3280.86	3172.08	3062.90	2953.35
3	3362.45	3255.800	3148.800	3041.22	2933.008	2824.41	2715.24
4	3117.45	3011.800	2905.22	2798.02	2690.149	2581.60	2472.04
5	2868.60	2763.09	2656.72	2549.52	2441.149	2332.66	2223.04
6	2613.81	2508.14	2401.48	2293.84	2185.24	2075.69	1965.20
7	2351.13	2244.87	2137.49	2028.98	1919.36	1808.64	1696.82

V	J= 50
0	3310.49
1	3077.90
2	2843.47
3	2605.61
4	2362.61
5	2112.95
6	1853.78
7	1583.91

Table 8c. Line Positions of HF, P-Branch, Δv = 3 Sequence

NU(V,J,-1) , 1/CM , P-BRANCH , DELTA NU = 3

V	J= 1	2	3	4	5	6	7
0	11331.88	11266.30	11236.31	11181.96	11123.32	11060.45	10993.42
1	10830.67	10786.75	10786.52	10686.04	10629.37	10568.57	10503.71
2	10342.08	10299.75	10253.22	10202.52	10147.73	10088.90	10026.10
3	9864.47	9823.56	9778.65	9729.67	9676.66	9619.69	9558.81
4	9393.30	9356.20	9312.86	9807.50	9214.18	9158.89	9047.89
5	8935.30	8895.49	8853.65	8807.85	8758.13	8704.55	8647.16
6	8475.43	8439.03	8398.65	8354.33	8306.12	8254.07	8198.24

V	J= 8	9	10	11	12	13	14
0	10922.30	10847.17	10768.17	10685.17	10598.47	10508.07	10414.06
1	10434.86	10362.09	10285.47	10205.07	10120.98	10033.27	9942.02
2	9954.89	9888.82	9814.37	9735.44	9654.09	9565.15	9480.85
3	9494.02	9425.59	9353.18	9277.52	9198.09	9115.15	9028.78
4	9037.02	8970.18	8900.18	8826.32	8748.93	8668.07	8583.81
5	8586.02	8521.45	8452.72	8380.58	8306.13	8226.13	8143.75
6	8138.68	8075.45	8008.60	7938.18	7864.27	7786.92	7706.18

V	J= 15	16	17	18	19	20	21
0	10316.53	10215.57	10111.26	10003.70	9892.97	9779.17	9662.39
1	9847.75	9749.24	9647.88	9543.82	9435.20	9324.89	9210.11
2	9389.05	9294.43	9194.80	9092.43	8986.93	8878.75	8768.75
3	8939.02	8846.36	8749.90	8649.43	8548.09	8442.57	8334.21
4	8496.02	8405.36	8311.37	8214.12	8118.07	8010.63	7904.47
5	8058.04	7969.08	7876.92	7781.64	7683.28	7581.92	7477.62
6	7622.11	7534.78	7444.25	7350.56	7253.79	7153.98	7051.19

V	J= 22	23	24	25	26	27	28
0	9542.71	9420.23	9295.04	9167.22	9036.87	8904.07	8768.91
1	9094.68	8975.35	8853.33	8728.69	8601.52	8471.88	8339.87
2	8655.40	8538.03	8419.73	8297.93	8173.58	8046.75	7917.51
3	8223.94	8109.03	7992.35	7873.02	7751.13	7626.72	7499.89
4	7795.43	7683.04	7569.08	7451.87	7332.04	7209.66	7084.78
5	7370.43	7260.61	7147.63	7032.13	6914.97	6793.21	6669.88
6	6945.47	6836.89	6725.48	6611.30	6494.39	6374.81	6252.58

V	J= 29	30	31	32	33	34	35
0	8631.47	8491.83	8350.07	8206.26	8060.49	7912.82	7763.33
1	8205.56	8069.01	7930.31	7789.52	7646.70	7501.23	7355.25
2	7785.94	7652.10	7516.04	7377.84	7237.56	7095.23	6950.89
3	7370.64	7239.08	7105.25	6969.21	6834.05	6690.66	6548.26
4	6957.47	6827.76	6695.71	6561.36	6424.75	6285.93	6144.02
5	6545.72	6415.72	6284.98	6151.84	6016.35	5878.53	5738.40
6	6127.75	6000.36	5870.44	5738.02	5603.12	5465.77	5325.98

Table 8c. Line Positions of HF, P-Branch, $\Delta v = 3$ Sequence (Continued)

NU(V,J,-1) 1/CM , P-BRANCH , DELTA NU = 3

V	J= 36	37	38	39	40	41	42
0	7612.07	7459.11	7304.52	7148.34	6990.63	6831.44	6670.82
1	7206.73	7056.42	6904.37	6750.63	6595.24	6438.26	6279.69
2	6804.68	6657.56	6506.58	6354.80	6201.34	6045.93	5888.91
3	6401.76	6257.37	6108.96	5958.65	5806.13	5654.20	5496.96
4	6001.76	5856.48	5709.11	5559.65	5408.13	5254.57	5098.96
5	5593.90	5451.34	5302.44	5152.35	5003.94	4856.37	4904.58
6	5183.78	5039.17	4892.15	4742.75	4590.94	4436.74	4280.12

V	J= 43	44	45	46	47	48	49
0	6508.80	6345.42	6180.73	6014.74	5847.49	5678.99	5509.28
1	6119.59	5957.98	5794.08	5630.31	5464.30	5296.85	5127.97
2	5730.209	5569.81	5407.76	5244.06	5078.72	4911.74	4743.12
3	5338.292	5178.64	5016.98	4853.55	4688.29	4521.17	4352.19
4	4941.56	4781.64	4618.92	4456.16	4288.33	4122.43	3952.19
5	4536.56	4376.31	4213.81	4049.04	3881.99	3712.63	3540.92
6	4121.07	3959.58	3795.62	3629.17	3460.20	3288.66	3114.53

V	J= 50
0	5338.36
1	4957.68
2	4572.86
3	4181.31
4	3780.31
5	3366.84
6	2937.75

Table 8d. Line Positions of HF, P-Branch, Δv = 4 Sequence

NU(V,J,-1) , 1/CM , P-BRANCH , DELTA NU = 4

J	v=0	v=1	v=2	v=3	v=4	v=5
1	14790.71	14710.98	13484.87	12852.86	12231.21	11616.83
2	14743.69	14084.65	13441.16	12810.72	12190.58	11577.66
3	14690.83	14033.61	13391.85	12764.52	12144.52	11533.13
4	14632.18	13976.91	13337.01	12709.99	12093.10	11483.28
5	14567.81	13914.62	13276.68	12651.52	12036.36	11428.16
6	14497.78	13846.80	13210.95	12587.72	11974.37	11367.83
7	14422.18	13773.53	13139.86	12518.66	11907.18	11302.36
8	14341.08	13694.80	13063.49	12444.41	11834.86	11231.79
9	14254.55	13610.93	12981.92	12365.07	11757.47	11156.19
10	14162.70	13521.76	12895.23	12280.09	11675.04	11075.64
11	14065.59	13427.45	12803.48	12191.78	11587.78	10990.18
12	13963.38	13328.07	12706.77	12096.86	11495.61	10899.89
13	13856.92	13223.76	12605.18	11997.75	11398.67	10804.84
14	13743.74	13114.56	12498.78	11893.87	11297.01	10705.10
15	13626.59	13000.58	12387.03	11780.03	11190.72	10600.74
16	13504.92	12881.92	12272.22	11672.95	11079.88	10491.82
17	13378.12	12758.67	12151.69	11554.60	10964.55	10378.41
18	13247.00	12630.93	12026.97	11432.57	10844.82	10260.59
19	13111.43	12498.80	11897.93	11306.77	10720.77	10138.43
20	12971.51	12363.37	11765.61	11175.61	10592.46	10011.99
21	12827.36	12251.75	11627.12	11010.84	10459.97	9881.34
22	12679.07	12077.03	11485.55	10901.98	10323.39	9746.55
23	12526.76	11928.31	11339.99	10759.13	10182.77	9607.68
24	12370.53	11775.68	11190.52	10612.35	10038.19	9464.79
25	12210.49	11619.25	11037.24	10461.72	9889.72	9317.94
26	12046.74	11459.10	10880.22	10307.33	9737.43	9167.20
27	11879.37	11295.34	10719.55	10149.24	9581.37	9012.61
28	11708.50	11128.04	10655.11	9987.53	9421.61	8854.22
29	11534.21	10957.29	10387.58	9822.25	9258.20	8692.08
30	11356.61	10216.42	10041.92	9653.48	8926.24	8356.73
31	11175.79	10605.80	10041.92	9481.27	8920.68	8183.60
32	10991.82	10425.22	9864.14	9305.68	8746.65	8006.86
33	10804.81	10241.51	9683.13	9126.76	8569.16	8006.86
34	10614.83	10054.74	9498.97	8944.56	8388.26	7826.54
35	10421.96	9864.98	9311.70	8759.12	8203.96	7642.66
36	10226.27	9672.28	9121.37	8570.48	8016.30	7455.24
37	10027.83	9476.02	8928.08	8378.66	7825.24	7264.28
38	9826.70	9278.32	8731.70	8183.70	7630.95	7069.78
39	9622.94	9077.15	8532.43	7985.61	7433.29	6871.75
40	9416.60	8873.23	8330.24	7784.41	7232.30	6670.15
41	9207.72	8666.61	8125.15	7580.10	7027.98	6464.99
42	8996.35	8457.30	7917.49	7372.69	6820.31	6256.22

Table 8d. Line Positions of HF, P-Branch, Δv = 4 Sequence (Continued)

$$NU(V,J,-1) \; , \; 1/CM \; , \; P\text{-}BRANCH \; , \; DELTA \; NU = 4$$

V	J= 43	44	45	46	47	48	49
0	8782.52	8566.26	8347.58	8126.50	7903.02	7677.14	7448.85
1	8245.32	8030.70	7813.43	7593.51	7370.94	7145.69	6917.75
2	7706.316	7492.56	7275.93	7056.39	6833.92	6608.49	6380.06
3	7162.16	6948.86	6731.68	6511.69	6288.48	6062.00	5832.21
4	6609.28	6394.86	6177.01	5955.68	5730.83	5502.40	5270.32
5	6043.83	5827.75	5607.95	5384.38	5156.95	4925.60	4690.25

V	J= 50
0	7218.14
1	6687.07
2	6148.59
3	5599.03
4	5034.50
5	4450.81

Table 8e. Line Positions of HF, P-Branch, $\Delta v = 5$ Sequence

NU(V,J,-1) , 1/CM , P-BRANCH , DELTA NU = 5

J	V	value
1	0	18090.97
1	1	17272.40
1	2	16473.60
1	3	15688.60
1	4	14914.74
2	0	18041.65
2	1	17226.32
2	2	16428.32
2	3	15645.10
2	4	14872.75
3	0	17985.92
3	1	17172.24
3	2	16376.28
3	3	15594.74
3	4	14824.00
4	0	17923.05
4	1	17111.39
4	2	16317.33
4	3	15537.59
4	4	14768.53
5	0	17853.97
5	1	17043.54
5	2	16251.54
5	3	15473.70
5	4	14706.39
6	0	17776.04
6	1	16968.98
6	2	16178.13
6	3	15403.13
6	4	14637.65
7	0	17692.00
7	1	16887.00
7	2	16099.71
7	3	15325.96
7	4	14562.38
8	0	17601.10
8	1	16796.51
8	2	16013.02
8	3	15242.24
8	4	14480.63
9	0	17503.40
9	1	16704.04
9	2	15921.07
9	3	15152.07
9	4	14392.48
10	0	17398.99
10	1	16602.51
10	2	15822.45
10	3	15055.51
10	4	14298.01
11	0	17287.97
11	1	16494.49
11	2	15717.16
11	3	14952.65
11	4	14197.28
12	0	17170.44
12	1	16380.08
12	2	15605.57
12	3	14843.56
12	4	14090.38
13	0	17046.51
13	1	16259.38
13	2	15487.77
13	3	14728.34
13	4	13977.38
14	0	16916.28
14	1	16132.49
14	2	15363.87
14	3	14607.07
14	4	13858.37
15	0	16779.86
15	1	15992.51
15	2	15233.09
15	3	14479.84
15	4	13733.42
16	0	16637.37
16	1	15866.54
16	2	15098.14
16	3	14346.14
16	4	13601.xx
17	0	16488.92
17	1	15715.70
17	2	14956.15
17	3	14207.85
17	4	13466.04
18	0	16334.63
18	1	15565.10
18	2	14809.12
18	3	14063.28
18	4	13323.78
19	0	16174.61
19	1	15408.83
19	2	14656.15
19	3	13913.11
19	4	13175.91
20	0	16008.99
20	1	15247.02
20	2	14497.65
20	3	13757.43
20	4	13022.52
21	0	15837.89
21	1	15079.76
21	2	14333.75
21	3	13596.34
21	4	12863.70
22	0	15661.43
22	1	14907.18
22	2	14164.52
22	3	13429.92
22	4	12699.51
23	0	15479.72
23	1	14729.39
23	2	13990.08
23	3	13258.26
23	4	12530.03
24	0	15292.89
24	1	14546.48
24	2	13810.52
24	3	13081.46
24	4	12355.35
25	0	15101.05
25	1	14358.56
25	2	13625.94
25	3	12899.58
25	4	12175.53
26	0	14904.32
26	1	14165.75
26	2	13436.43
26	3	12712.72
26	4	11990.65
27	0	14702.82
27	1	13968.14
27	2	13242.07
27	3	12520.96
27	4	11800.77
28	0	14496.66
28	1	13765.33
28	2	13042.97
28	3	12324.36
28	4	11605.95
29	0	14285.95
29	1	13558.19
29	2	12839.19
29	3	12122.99
29	4	11406.26
30	0	14079.78
30	1	13347.51
30	2	12630.82
30	3	11916.07
30	4	11201.73
31	0	13851.68
31	1	13131.68
31	2	12417.94
31	3	11706.24
31	4	10992.44
32	0	13677.53
32	1	12911.53
32	2	12200.61
32	3	11494.97
32	4	10778.40
33	0	13399.62
33	1	12687.08
33	2	11978.90
33	3	11271.17
33	4	10559.67
34	0	13147.65
34	1	12458.47
34	2	11752.87
34	3	11046.89
34	4	10336.27
35	0	12931.79
35	1	12225.56
35	2	11522.56
35	3	10818.16
35	4	10108.22
36	0	12691.83
36	1	11988.97
36	2	11288.03
36	3	10585.01
36	4	9875.54
37	0	12448.13
37	1	11748.18
37	2	11049.32
37	3	10347.47
37	4	9638.23
38	0	12200.65
38	1	11503.78
38	2	10806.44
38	3	10105.55
38	4	9396.30
39	0	11949.45
39	1	11254.78
39	2	10559.43
39	3	9859.25
39	4	9149.73
40	0	11692.58
40	1	11002.30
40	2	10308.30
40	3	9608.58
40	4	8898.50
41	0	11436.07
41	1	10745.82
41	2	10053.51
41	3	9353.51
41	4	8642.59
42	0	11173.96
42	1	10485.55
42	2	9793.68
42	3	9094.04
42	4	8381.95

Table 8e. Line Positions of HF, P-Branch, $\Delta v = 5$ Sequence (Continued)

$$NU(V,J,-1) , 1/CM , P-BRANCH , DELTA NU = 5$$

	J= 43	44	45	46	47	48	49
V= 0	10908.26	10638.98	10366.13	10089.70	9809.66	9525.98	9238.63
1	10221.43	9953.45	9681.60	9405.84	9126.14	8842.44	8554.69
2	9530.18	9262.51	8990.64	8714.53	8434.11	8149.33	7860.08
3	8830.12	8561.71	8288.76	8011.21	7728.98	7441.97	7150.09
4	8116.55	7846.30	7571.15	7291.02	7005.79	6715.37	6419.65

	J= 50
V= 0	8947.53
1	8262.80
2	7566.29
3	6853.23
4	6118.47

-32-

Table 8f.   Line Positions of HF, P-Branch, Δv = 6 Sequence

NU(V,J,-1) , 1/CM , P-BRANCH , DELTA NU = 6

v=	J= 1	2	3	4	5	6	7
0	21232.81	21183.00	21124.55	21057.53	20982.01	20898.06	20805.76
1	20260.30	20213.22	20156.67	20094.71	20073.43	19936.88	19847.15
2	19309.13	19262.70	19207.94	19144.93	19073.72	18994.39	18907.01
3	18372.13	18327.28	18274.22	18213.02	18143.73	18066.41	17981.15

v=	J= 8	9	10	11	12	13	14
0	20705.21	20596.50	20479.73	20355.01	20222.43	20082.13	19934.20
1	19749.32	19643.49	19529.73	19408.16	19278.87	19141.98	18997.58
2	18811.65	18708.41	18597.37	18478.61	18352.25	18218.37	18077.07
3	17888.02	17787.08	17678.43	17562.15	17438.33	17307.06	17168.43

v=	J= 15	16	17	18	19	20	21
0	19778.78	19615.99	19445.95	19268.79	19084.64	18893.64	18695.91
1	18845.79	18686.72	18520.50	18347.23	18167.05	17980.03	17786.39
2	17928.46	17772.65	17609.74	17439.83	17263.00	17079.48	16889.25
3	17022.53	16869.47	16709.34	16542.23	16368.25	16187.50	16000.06

v=	J= 22	23	24	25	26	27	28
0	18491.58	18280.80	18063.68	17840.36	17610.97	17375.63	17134.46
1	17586.15	17379.48	17166.48	16947.27	16721.96	16490.66	16253.49
2	16690.46	16489.22	16279.53	16063.80	15841.82	15613.79	15379.79
3	15806.04	15605.53	15398.62	15185.39	14965.95	14740.35	14508.69

v=	J= 29	30	31	32	33	34	35
0	16887.58	16635.11	16377.16	16113.82	15845.20	15571.39	15292.46
1	16010.54	15761.91	15557.70	15247.98	14982.85	14712.37	14436.61
2	15139.93	14894.28	14642.91	14385.90	14123.31	13855.20	13581.60
3	14271.04	14027.45	13778.00	13522.72	13261.68	12994.90	12722.42

v=	J= 36	37	38	39	40	41	42
0	15008.51	14719.59	14425.76	14127.08	13823.58	13515.28	13202.21
1	14155.63	13869.48	13578.18	13283.07	12980.30	12673.73	12360.07
2	13302.57	13018.12	12728.29	12433.07	12132.46	11826.46	11515.03
3	12444.25	12160.41	11870.89	11575.69	11274.78	10968.13	10655.68

Table 8f. Line Positions of HF, P-Branch, $\Delta v = 6$ Sequence (Continued)

NU(V,J,-1) , 1/CM , P-BRANCH , DELTA NU = 6

V=	J= 43	44	45	46	47	48	49
0	12884.36	12561.74	12234.30	11902.03	11564.86	11222.74	10875.57
1	12045.30	11723.39	11396.31	11063.98	10726.33	10383.28	10034.71
2	11198.14	10875.72	10547.72	10214.05	9874.61	9529.30	9177.97
3	10337.38	10013.16	9682.91	9346.55	9003.94	8654.95	8299.42

V=	J= 50
0	10523.56
1	9680.48
2	8820.48
3	7937.19

- 34 -

Table 8g.   Line Positions of HF, P-Branch. Δv = 7 Sequence

NU(V,J,-1) , 1/CM , P-BRANCH , DELTA NU = 7

J	v = 0	v = 1	v = 2
1	24221.34	23097.04	21992.66
2	24170.16	23047.59	21944.87
3	24108.98	22988.33	21887.42
4	24037.86	22919.31	21820.36
5	23956.87	22840.61	21743.75
6	23866.09	22752.29	21657.67
7	23765.62	22654.44	21562.20
8	23655.54	22547.16	21457.42
9	23535.95	22430.53	21343.42
10	23406.96	22304.64	21220.29
11	23268.68	22169.62	21088.12
12	23121.23	22025.56	20947.02
13	22964.73	21872.57	20797.08
14	22799.29	21710.78	20638.43
15	22625.06	21540.29	20471.16
16	22442.17	21361.24	20295.38
17	22250.74	21173.75	20111.22
18	22050.93	20977.94	19918.78
19	21842.86	20773.94	19718.19
20	21626.68	20561.88	19509.54
21	21402.53	20341.89	19292.97
22	21170.55	20114.09	19068.58
23	20930.89	19878.62	18836.48
24	20683.68	19635.58	18596.79
25	20429.07	19385.12	18349.61
26	20167.18	19127.35	18095.04
27	19898.15	18862.37	17833.18
28	19622.12	18586.32	17564.13
29	19339.20	18311.28	17287.78
30	19049.51	18025.37	17004.80
31	18753.17	17732.67	16714.67
32	18450.29	17443.28	16417.66
33	18140.96	17127.26	16113.82
34	17825.28	16814.70	15803.21
35	17503.33	16495.65	15485.86
36	17175.18	16176.17	15161.81
37	16840.89	15838.28	14831.06
38	16500.51	15500.03	14493.63
39	16154.09	15155.42	14149.51
40	15801.64	14804.46	13798.67
41	15443.19	14447.13	13441.08
42	15078.72	14083.42	13076.68
43	14708.23	13713.26	12705.40
44	14331.68	13336.61	12327.17
45	13949.01	12953.39	11941.87
46	13560.16	12563.50	11549.38
47	13165.05	12166.83	11149.57
48	12763.57	11763.83	10742.27
49	12355.59	11363.25	10327.30
50	11940.97	10934.70	9904.45

Table 8h. Line Positions of HF, P-Branch, Δv = 8 Sequence

NU(V,J,-1) , 1/CM , P-BRANCH , DELTA NU = 8

	1	2	3	4	5	6	7
J=	1	2	3	4	5	6	7
V= 0	27057.07	27004.54	26940.64	26865.45	26779.05	26681.50	26572.91
1	25780.57	25729.77	25667.81	25594.74	25510.63	25415.57	25309.64
J=	8	9	10	11	12	13	14
V= 0	26453.37	26322.99	26181.87	26030.14	25867.91	25695.32	25512.49
1	25192.93	25065.54	24927.56	24779.12	24620.32	24451.29	24272.13
J=	15	16	17	18	19	20	21
V= 0	25319.57	25116.69	24904.00	24681.63	24449.75	24208.50	23958.03
1	24082.99	23883.98	23675.24	23456.89	23229.09	22991.95	22745.61
J=	22	23	24	25	26	27	28
V= 0	23698.49	23430.03	23152.79	22866.92	22572.57	22269.86	21958.94
1	22490.21	22225.88	21952.74	21670.93	21380.57	21081.77	20774.66
J=	29	30	31	32	33	34	35
V= 0	21639.94	21312.97	20978.15	20635.59	20285.38	19927.61	19562.37
1	20459.33	20135.89	19804.43	19465.03	19117.77	18762.71	18399.91
J=	36	37	38	39	40	41	42
V= 0	19189.71	18809.69	18422.36	18027.72	17625.81	17216.60	16800.07
1	18029.41	17651.22	17265.38	16871.86	16470.67	16061.75	15645.06
J=	43	44	45	46	47	48	49
V= 0	16376.19	15944.89	15506.09	15059.69	14605.55	14143.54	13673.47
1	15220.53	14788.06	14347.54	13898.83	13441.79	12976.22	12501.92
J=	50						
V= 0	13195.16						
1	12018.66						

Table 8i. Line Positions of HF, P-Branch, $\Delta v = 9$ Sequence

NU(V,J,-1) , 1/CM , P-BRANCH , DELTA NU = 9

	1	2	3	4	5	6	7
J=	1	2	3	4	5	6	7
V= 0	29740.60	29686.72	29620.12	29540.88	29449.07	29344.78	29228.11
J=	8	9	10	11	12	13	14
V= 0	29099.14	28958.00	28804.79	28639.64	28462.68	28274.04	28073.85
J=	15	16	17	18	19	20	21
V= 0	27862.26	27639.42	27405.48	27160.59	26904.90	26638.57	26361.75
J=	22	23	24	25	26	27	28
V= 0	26074.61	25777.29	25469.95	25152.73	24825.79	24489.26	24143.28
J=	29	30	31	32	33	34	35
V= 0	23787.98	23423.49	23049.30	22667.34	22275.88	21875.62	21466.63
J=	36	37	38	39	40	41	42
V= 0	21048.95	20622.63	20187.70	19744.17	19292.01	18831.21	18361.72
J=	43	44	45	46	47	48	49
V= 0	17883.46	17396.34	16900.24	16395.02	15880.51	15356.51	14822.80
J=	50						
V= 0	14279.12						

Table 9a.   Line Positions of HF, R-Branch, Δv = 1 Sequence

NU(V,J,+1) , 1/CM , R-BRANCH , DELTA NU = 1

v=	J= 0	1	2	3	4	5	6
0	4001.15	4039.12	4075.45	4110.08	4142.99	4174.11	4203.42
1	3827.47	3863.08	3898.89	3932.15	3963.73	3993.57	4021.69
2	3658.56	3693.67	3727.19	3759.10	3789.37	3817.95	3844.79
3	3493.09	3527.66	3559.81	3590.40	3619.01	3646.69	3672.31
4	3333.06	3365.09	3396.16	3425.42	3453.02	3479.17	3503.87
5	3175.15	3206.09	3235.55	3263.50	3289.00	3314.70	3337.43
6	3019.53	3049.11	3077.25	3103.88	3128.99	3152.51	3174.43
7	2865.37	2893.62	2920.42	2945.74	2969.53	2991.77	3012.51
8	2711.82	2738.72	2764.18	2788.16	2810.64	2831.56	2850.89

v=	J= 7	8	9	10	11	12	13
0	4230.87	4256.42	4280.05	4301.74	4321.38	4339.08	4354.63
1	4047.91	4072.32	4094.86	4115.49	4134.17	4150.88	4165.59
2	3869.88	3893.16	3914.60	3934.19	3951.83	3967.58	3981.39
3	3696.28	3718.35	3738.46	3757.19	3773.85	3788.58	3801.42
4	3526.28	3547.25	3566.46	3583.89	3599.45	3613.17	3625.01
5	3358.93	3379.27	3397.21	3415.25	3428.99	3440.70	3451.75
6	3194.59	3213.74	3230.17	3245.25	3258.99	3270.68	3279.16
7	3031.41	3048.74	3054.37	3078.25	3090.82	3100.08	3109.60
8	2868.59	2884.62	2898.96	2911.56	2922.00	2931.45	2938.66

v=	J= 14	15	16	17	18	19	20
0	4368.17	4379.61	4388.94	4396.10	4401.20	4404.10	4404.83
1	4170.28	4183.92	4197.80	4204.54	4208.40	4210.69	4210.85
2	3992.31	4003.01	4010.18	4016.31	4020.22	4021.84	4021.35
3	3812.93	3821.35	3828.95	3833.00	3836.20	3836.87	3835.67
4	3634.93	3647.25	3648.95	3653.49	3655.07	3655.60	3653.05
5	3463.09	3467.74	3472.42	3474.99	3476.11	3476.07	3472.63
6	3287.55	3291.52	3297.42	3299.45	3299.12	3297.58	3294.63
7	3115.79	3120.74	3123.33	3124.65	3123.12	3120.04	3114.95
8	2944.02	2947.48	2949.04	2948.65	2946.29	2941.94	2935.56

v=	J= 21	22	23	24	25	26	27
0	4403.38	4399.75	4393.93	4385.03	4375.68	4363.26	4348.62
1	4208.77	4204.07	4197.47	4190.02	4179.18	4166.03	4151.66
2	4018.77	4014.07	4007.25	3998.29	3987.18	3973.93	3958.14
3	3832.09	3826.03	3819.56	3809.98	3798.27	3784.42	3768.47
4	3648.71	3642.68	3634.58	3622.38	3611.07	3597.28	3580.57
5	3467.65	3460.68	3451.58	3440.38	3427.07	3411.63	3394.04
6	3287.65	3279.61	3269.49	3257.97	3242.95	3226.48	3207.85
7	3107.14	3098.62	3087.25	3073.97	3058.49	3040.79	3020.94
8	2927.14	2916.64	2904.05	2889.33	2872.46	2853.42	2832.16

Table 9a. Line Positions of HF, R-Branch, Δv = 1 Sequence (Continued)

NU(V,J,+1) , 1/CM , R-BRANCH , DELTA NU = 1

V	J= 28	29	30	31	32	33	34
0	4331.77	4312.72	4291.44	4267.95	4242.24	4214.29	4184.11
1	4134.50	4115.15	4093.60	4069.85	4043.88	4015.68	3985.29
2	3940.91	3921.14	3899.18	3875.02	3848.64	3820.04	3789.08
3	3750.26	3729.92	3707.40	3682.67	3655.72	3626.04	3595.08
4	3563.69	3540.63	3517.38	3491.92	3464.21	3434.25	3402.09
5	3374.04	3352.34	3328.78	3301.79	3273.15	3242.21	3208.95
6	3187.09	3164.030	3138.78	3111.27	3081.46	3049.34	3014.85
7	2968.89	2874.600	2948.05	2919.21	2888.03	2854.48	2818.52
8	2808.66	2782.90	2754.83	2724.42	2691.63	2656.41	2618.72

V	J= 35	36	37	38	39	40	41
0	4151.68	4117.00	4080.03	4040.77	3999.19	3955.25	3908.93
1	4052.57	3817.61	3880.36	3840.07	3798.88	3754.58	3707.85
2	3756.07	3720.67	3682.94	3642.87	3600.41	3557.53	3508.17
3	3561.44	3525.29	3486.88	3446.09	3402.88	3357.18	3308.94
4	3367.36	3330.53	3291.22	3249.48	3205.69	3158.50	3109.14
5	3167.96	3130.34	3094.90	3051.97	3006.40	2958.41	2907.65
6	2977.36	2938.62	2896.79	2852.40	2805.40	2755.71	2703.26
7	2780.61	2739.17	2695.68	2649.56	2600.74	2549.15	2494.71
8	2578.51	2535.71	2490.28	2442.13	2391.19	2337.39	2280.62

V	J= 42	43	44	45	46	47	48
0	3860.17	3808.93	3755.16	3698.77	3639.74	3577.87	3513.17
1	3658.64	3606.89	3550.54	3493.52	3435.73	3373.10	3307.50
2	3458.21	3404.61	3350.61	3292.60	3233.93	3168.21	3104.43
3	3258.13	3204.61	3148.36	3089.27	3027.23	2962.14	2893.88
4	3054.13	3027.338	2944.718	2876.415	2820.562	2541.677	2683.79
5	2847.97	2589.73	2738.45	2676.018	2620.566	2551.677	2469.65
6	2647.97	2589.73	2528.45	2464.018	2396.207	2325.14	2250.42
7	2437.31	2376.87	2313.27	2246.38	2176.207	2102.19	2024.59
8	2220.80	2157.80	2091.52	2021.81	1948.54	1871.55	1790.67

V	J= 49
0	3445.48
1	3231.45
2	3022.18
3	2610.18
4	2393.185
5	2171.95
6	1943.95
7	1705.71

Table 9b. Line Positions of HF, R-Branch, $\Delta v = 2$ Sequence

NU(V,J+1) , 1/CM , R-BRANCH , DELTA NU = 2

v	J=0	1	2	3	4	5	6
0	7789.06	7824.02	7855.84	7884.47	7909.87	7932.01	7950.86
1	7448.00	7484.58	7517.09	7539.49	7563.75	7584.83	7602.69
2	7115.89	7148.75	7171.41	7203.59	7226.71	7246.50	7263.57
3	6791.89	6827.75	6850.69	6875.65	6897.60	6916.50	6932.33
4	6474.47	6503.92	6530.64	6554.77	6577.15	6592.93	6597.99
5	6163.90	6190.72	6224.88	6238.06	6257.94	6274.54	6288.66
6	5853.90	5880.76	5904.84	5926.06	5944.39	5950.81	5972.66
7	5547.55	5573.09	5595.84	5615.76	5632.82	5645.97	5658.18

v	J=7	8	9	10	11	12	13
0	7966.31	7978.54	7987.32	7992.71	7994.65	7993.23	7988.34
1	7617.31	7628.66	7636.72	7641.45	7642.85	7640.90	7635.39
2	7277.26	7287.75	7295.06	7299.04	7299.80	7297.12	7291.49
3	6945.39	6954.64	6961.06	6964.29	6964.07	6961.12	6954.79
4	6620.13	6628.00	6630.50	6635.87	6635.07	6631.10	6623.93
5	6298.76	6306.38	6310.88	6312.29	6310.57	6305.70	6297.06
6	5981.73	5988.19	5991.59	5991.93	5989.16	5983.28	5974.26
7	5666.42	5671.66	5673.87	5673.02	5669.09	5662.04	5651.86

v	J=14	15	16	17	18	19	20
0	7979.99	7968.20	7952.95	7934.25	7912.10	7886.50	7857.47
1	7626.90	7614.87	7599.39	7580.50	7558.33	7532.74	7503.76
2	7282.20	7269.87	7254.81	7235.00	7212.57	7185.72	7157.72
3	6944.00	6932.04	6915.81	6896.00	6873.09	6847.41	6818.21
4	6613.57	6602.95	6583.11	6563.03	6539.08	6513.08	6483.11
5	6286.07	6272.07	6235.46	6233.62	6209.54	6182.22	6151.65
6	5962.07	5946.07	5928.13	5906.36	5881.49	5852.09	5821.06
7	5638.52	5622.00	5602.29	5579.36	5553.19	5523.76	5491.06

v	J=21	22	23	24	25	26	27
0	7825.02	7789.15	7749.88	7707.23	7661.21	7611.85	7559.14
1	7471.41	7435.47	7396.64	7354.24	7308.25	7259.46	7207.40
2	7125.35	7089.57	7050.12	7008.17	6962.48	6912.58	6861.25
3	6787.06	6749.95	6710.93	6667.57	6621.72	6572.72	6520.15
4	6459.06	6413.64	6373.03	6330.62	6284.69	6235.98	6182.25
5	6117.80	6080.28	6040.28	5996.59	5949.66	5905.41	5845.60
6	5785.78	5748.72	5707.35	5662.67	5617.85	5583.13	5508.99
7	5455.08	5415.78	5373.16	5327.19	5277.85	5225.13	5168.99

v	J=28	29	30	31	32	33	34
0	7503.12	7443.49	7381.27	7315.32	7246.19	7173.80	7098.16
1	7151.70	7092.49	7030.27	6964.78	6896.05	6823.99	6748.09
2	6805.70	6746.86	6684.74	6619.48	6550.65	6478.67	6403.94
3	6464.42	6405.42	6343.68	6277.48	6208.09	6136.26	6060.64
4	6126.68	6066.11	6003.68	5937.56	5867.09	5795.08	5718.03
5	5788.60	5728.30	5664.65	5597.68	5527.09	5453.08	5375.29
6	5450.51	5389.00	5324.07	5255.68	5183.79	5108.38	5029.39
7	5109.41	5046.36	4979.81	4909.71	4836.04	4758.74	4677.76

Table 9b.   Line Positions of HF, R-Branch, Δv = 2 Sequence (Continued)

NU(V,J,+1) , 1/CM , R-BRANCH , DELTA NU = 2

V=	J= 35	36	37	38	39	40	41
0	7019.28	6937.15	6851.77	6763.12	6671.18	6575.92	6477.31
1	6670.12	6588.26	6503.10	6414.61	6322.77	6227.73	6128.84
2	6324.79	6242.84	6157.54	6068.83	5976.69	5881.07	5781.89
3	5981.64	5899.24	5813.40	5724.08	5631.22	5534.78	5434.68
4	5638.90	5555.09	5468.85	5378.48	5284.47	5186.75	5085.25
5	5294.64	5210.47	5121.91	5030.03	4934.40	4834.92	4731.51
6	5046.77	4860.47	4770.43	4676.57	4578.81	4477.06	4371.22
7	4593.04	4504.52	4412.12	4315.76	4215.36	4110.80	4001.97

V=	J= 42	43	44	45	46	47	48
0	6375.29	6269.82	6160.83	6048.22	5931.93	5811.82	5687.79
1	6026.65	5920.90	5811.50	5698.36	5581.38	5460.43	5335.38
2	5679.11	5572.63	5462.37	5348.01	5230.07	5107.78	4981.20
3	5330.83	5223.16	5111.56	4995.01	4876.08	4751.92	4623.27
4	4979.86	4870.50	4757.04	4639.35	4517.30	4390.71	4259.43
5	4624.07	4512.48	4396.62	4276.54	4151.49	4021.89	3887.36
6	4261.18	4146.81	4027.97	3904.54	3776.26	3643.03	3504.61
7	3888.76	3771.02	3648.60	3521.34	3389.04	3251.52	3108.55

V=	J= 49
0	5559.69
1	5206.07
2	4850.19
3	4480.95
4	4127.24
5	3747.68
6	3360.79
7	2959.90

Table 9c. Line Positions of HF, R-Branch, $\Delta v = 3$ Sequence

NU(V,J,J+1) , 1/CM , R-BRANCH , DELTA NU = 3

J=	0	1	2	3	4	5	6
V=0	11409.59	11441.61	11469.03	11491.81	11509.89	11523.27	11531.91
1	10905.40	10936.10	10962.31	10983.98	11001.09	11013.59	11021.47
2	10413.89	10443.28	10468.28	10488.84	10504.94	10516.53	10523.59
3	9933.29	9961.39	9985.17	10004.60	10019.64	10030.27	10036.45
4	9461.63	9496.42	9510.97	9534.67	9543.34	9552.79	9558.01
5	8996.69	9022.18	9043.48	9060.24	9073.34	9081.85	9086.03
6	8536.08	8560.25	8580.27	8596.09	8607.68	8615.00	8618.03

J=	7	8	9	10	11	12	13
V=0	11535.78	11534.88	11529.18	11518.68	11503.80	11483.58	11458.35
1	11024.70	11023.26	11017.14	11006.32	10990.80	10970.58	10945.65
2	10526.16	10524.04	10517.40	10506.15	10490.94	10469.81	10444.71
3	10035.38	10028.16	10017.14	10016.29	9999.84	9517.67	9470.22
4	9558.85	9555.23	9547.17	9534.66	9517.67	9496.19	8992.18
5	9085.85	9081.30	9072.34	9058.97	9041.16	9018.90	8516.95
6	8616.74	8611.11	8601.10	8586.70	8567.88	8544.64	8516.95

J=	14	15	16	17	18	19	20
V=0	11536.62	11394.40	10854.84	10319.80	10262.03	10209.51	10150.32
1	10415.00	10380.66	10341.72	10298.18	10250.05	10197.34	10140.07
2	10415.00	9889.07	9849.97	9806.33	9758.14	9705.42	9648.18
3	9923.74	9677.75	8865.25	9321.24	9272.73	9221.70	9162.88
4	9430.74	8925.32	8885.16	8840.51	8791.37	8737.72	8679.58
5	8960.99	8448.18	8407.08	8361.49	8311.40	8256.80	8197.69
6	8484.80						

J=	21	22	23	24	25	26	27
V=0	11087.55	11020.40	10948.91	10871.44	10790.30	10706.68	10614.58
1	10578.26	10011.92	10439.08	10364.54	10283.80	10194.04	10109.84
2	10586.43	9443.43	9941.43	9865.74	9785.93	9701.67	9612.98
3	9100.64	9033.64	8962.64	8887.15	9292.73	9210.38	9161.21
4	8616.94	8549.79	8478.14	8401.98	8321.31	8236.11	8146.40
5	8134.05	8065.87	7993.16	7915.89	7834.06	7747.65	7656.64
6							

J=	28	29	30	31	32	33	34
V=0	10520.06	10421.15	10317.87	10210.26	10098.33	9982.10	9861.60
1	10019.87	9918.21	9015.83	9214.05	9108.07	9482.60	9562.89
2	9028.76	9422.36	9320.45	9214.06	9103.47	8988.40	8868.95
3	9028.14	8931.23	8829.39	8723.06	8612.28	8497.04	8377.32
4	8552.14	8442.53	8340.15	8233.27	8121.85	8005.12	7885.35
5	7953.03	7793.33	7849.95	7741.97	7629.31	7512.16	7390.16
6	7561.02	7460.76	7355.82	7246.19	7131.81	7012.64	6888.63

-42-

Table 9c. Line Positions of HF, R-Branch, Δv = 3 Sequence (Continued)

NU(V,J,+1) , 1/CM , R-BRANCH , DELTA NU = 3

V=	J= 35	36	37	38	39	40	41
0	9736.84	9607.81	9474.51	9336.94	9195.07	9048.87	8898.30
1	9238.84	9116.44	8977.70	8840.58	8699.05	8553.07	8402.56
2	8745.08	8616.80	8484.05	8346.82	8205.04	8058.67	7907.62
3	8253.00	8124.39	7991.03	7853.08	7712.43	7563.03	7410.78
4	7760.20	7650.86	7495.86	7356.55	7212.38	7063.27	6909.12
5	7263.45	7131.93	6995.54	6854.20	6707.81	6556.20	6399.48
6	6759.71	6625.82	6486.87	6342.77	6193.42	6038.70	5878.49

V=	J= 42	43	44	45	46	47	48
0	8743.31	8583.83	8419.78	8251.06	8077.56	7899.15	7715.67
1	8247.49	8087.75	7923.26	7753.89	7579.52	7400.00	7215.15
2	7751.83	7591.03	7425.57	7254.86	7078.91	6897.55	6710.60
3	7253.59	7091.11	6923.89	6751.11	6572.83	6388.86	6199.00
4	6749.80	6585.57	6415.17	6239.54	6058.13	5870.74	5677.13
5	6237.29	6069.57	5896.14	5716.84	5531.46	5339.78	5141.55
6	5712.63	5540.96	5363.31	5179.47	4989.23	4792.36	4588.58

V=	J= 49
0	7526.95
1	7024.79
2	6517.83
3	6003.01
4	5477.07
5	4936.51
6	4377.61

Table 9d. Line Positions of HF, R-Branch, $\Delta v = 4$ Sequence

NU(V,J,+1) , 1/CM , R-BRANCH , DELTA NU = 4

V	J= 0	1	2	3	4	5	6
0	14866.98	14896.14	14919.26	14936.30	14947.33	14952.03	14950.68
1	14203.30	14231.19	14253.18	14269.30	14279.32	14283.41	14280.69
2	13555.46	13581.92	13602.76	13617.79	13626.98	13630.29	13627.71
3	12920.46	12945.81	12965.49	12979.46	12987.68	12990.12	12986.77
4	12256.07	12320.09	12338.57	12351.57	12358.59	12360.08	12355.84
5	11678.87	11701.66	11718.90	11730.57	11736.63	11737.04	11731.80

V	J= 7	8	9	10	11	12	13
0	14943.17	14929.47	14909.60	14883.52	14851.32	14812.93	14768.40
1	14273.54	14259.55	14239.51	14213.42	14181.29	14143.12	14098.91
2	13619.20	13604.79	13584.44	13558.14	13525.91	13487.74	13443.64
3	12977.61	12962.61	12941.77	12915.08	12882.54	12844.14	12799.89
4	12345.87	12308.14	12308.63	12281.74	12248.26	12209.39	12164.72
5	11720.86	11704.22	11681.85	11653.74	11619.88	11580.26	11534.88

V	J= 14	15	16	17	18	19	20
0	14717.70	14660.97	14598.14	14529.26	14454.37	14373.52	14286.75
1	14048.20	13992.49	13930.32	13862.19	13788.16	13708.24	13622.48
2	13393.62	13337.70	13275.89	13208.24	13134.69	13055.36	12970.23
3	12749.80	12693.87	12632.11	12564.54	12491.18	12411.45	12327.15
4	12114.26	12058.00	11995.96	11928.14	11854.55	11775.21	11690.12
5	11483.73	11426.81	11364.12	11295.66	11221.43	11141.45	11055.70

V	J= 21	22	23	24	25	26	27
0	14194.09	14095.60	13991.37	13881.31	13765.60	13644.26	13517.37
1	13530.34	13482.71	13330.47	13221.69	13107.26	12987.20	12861.57
2	12879.22	12782.18	12680.39	12572.38	12458.74	12339.47	12214.62
3	12236.59	12140.75	12038.13	11930.54	11817.05	11698.57	11573.46
4	11599.29	11502.75	11430.49	11292.54	11178.89	11059.57	10934.56
5	10964.20	10866.95	10763.95	10655.20	10540.71	10420.45	10294.44

V	J= 28	29	30	31	32	33	34
0	13384.85	13246.87	13103.43	12954.58	12800.34	12640.74	12475.80
1	12730.39	12593.71	12451.53	12303.91	12150.84	11992.35	11828.45
2	12084.26	11948.23	11806.74	11659.73	11507.21	11349.18	11185.63
3	11443.16	11307.50	11165.87	11018.67	10866.17	10707.90	10543.99
4	10803.87	10667.50	10525.44	10377.62	10224.18	10064.93	9899.89
5	10162.66	10025.08	9881.70	9732.48	9577.39	9416.38	9249.40

V	J= 35	36	37	38	39	40	41
0	12305.55	12129.99	11949.11	11762.90	11571.35	11374.41	11172.03
1	11659.13	11484.39	11304.21	11118.56	10927.39	10730.66	10528.30
2	11016.50	10841.91	10661.03	10475.82	10284.25	10086.92	9883.73
3	10374.40	10199.10	10018.49	9831.04	9638.34	9439.55	9234.65
4	9729.01	9552.28	9369.49	9180.71	8985.79	8784.62	8577.08
5	9076.39	8897.28	8711.98	8520.40	8322.42	8117.92	7906.74

Table 9d. Line Positions of HF, R-Branch, Δv = 4 Sequence (Continued)

NU(V,J,+1) , 1/CM , R-BRANCH , DELTA NU = 4

V=	J= 42	43	44	45	46	47	48
0	10964.15	10750.69	10531.54	10306.59	10075.71	9838.72	9595.45
1	10320.21	10106.31	9886.46	9660.53	9428.36	9189.77	8944.55
2	10674.58	9459.35	9237.90	9010.07	8775.67	8534.50	8286.32
3	9C23.53	8806.04	8582.03	8351.30	8113.66	7868.88	7616.70
4	8363.02	8142.29	7914.70	7680.04	7438.1C	7188.62	6931.32
5	7688.73	7463.71	7231.48	6991.80	6744.44	6489.11	6225.52

V=	J= 49
0	9345.67
1	8692.45
2	8030.89
3	7356.85
4	6665.91
5	5953.33

-45-

Table 9e. Line Positions of HF, R-Branch, $\Delta v = 5$ Sequence

NU(V,J,+1) , 1/CM , R-BRANCH , DELTA NU = 5

J	v=0	v=1	v=2	v=3	v=4
0	18164.88	18191.23	18210.13	18221.55	18225.46
	17344.705	17369.82	17387.66	17398.18	17401.36
	16542.45	16566.34	16583.09	16592.66	16595.02
	15754.83	15777.48	15793.09	15801.64	15803.08
	14978.18	14999.56	15013.99	15021.44	15021.88
5	18221.85	18210.70			
	17397.15	17385.61			
	16590.15	16578.03			
	15797.42	15784.61			
	15015.28	15001.62			
7	18192.01	18165.76	18131.97	18090.65	18041.81
	17366.65	17340.30	17306.55	17265.42	17216.91
	16558.66	16537.52	16498.11	16456.76	16408.50
	15764.65	15737.52	15703.23	15661.76	15613.13
	14980.88	14953.06	14918.14	14876.11	14826.98
12	17985.47	17921.66			
	17161.04	17097.84			
	16352.83	16289.92			
	15557.34	15494.40			
	14770.75	14707.41			
14	17850.42	17771.77	17685.76	17592.44	17491.85
	17027.32	16949.52	16864.48	16772.22	16672.80
	16219.80	16142.49	16058.02	15966.43	15867.74
	15424.32	15347.12	15262.82	15171.44	15073.01
	14636.99	14559.49	14474.91	14383.28	14284.62
19	17384.06	17269.10			
	16566.26	16452.60			
	15761.98	15649.20			
	14967.55	14855.20			
	14178.93	14066.24			
21	17147.05	17017.95	16881.88	16738.90	16589.06
	16331.98	16204.35	16069.78	15928.34	15780.06
	15529.43	15402.72	15269.09	15128.59	14981.26
	14735.66	14609.28	14475.99	14335.81	14188.76
	13946.56	13819.91	13686.30	13545.76	13398.29
26	16432.42	16269.06			
	15625.00	15463.23			
	14827.13	14666.23			
	14034.86	13874.14			
	13243.91	13082.60			
28	16099.02	15922.36	15739.13	15549.38	15353.15
	15294.72	15119.58	14937.83	14749.49	14554.56
	14498.60	14324.25	14143.21	13955.49	13761.00
	13706.62	13522.29	13351.16	13163.24	12968.50
	12914.39	12739.26	12557.19	12368.18	12172.19
33	15150.47	14941.36			
	14353.13	14145.13			
	13560.04	13355.52			
	12766.94	12558.52			
	11969.19	11759.13			
35	14725.85	14503.94	14275.62	14040.89	13799.70
	13930.60	13709.66	13481.84	13247.56	13006.61
	13137.84	12916.95	12668.67	12453.88	12212.16
	12343.21	12120.95	11891.67	11655.30	11411.75
	11541.95	11317.58	11085.93	10846.91	10600.40
40	13552.01	13297.76			
	12758.92	12504.40			
	11963.44	11707.60			
	11160.90	10902.61			
	10346.26	10084.34			

Table 9e. Line Positions of HF, R-Branch, $\Delta v = 5$ Sequence (Continued)

NU(V,J,+1) , 1/CM , R-BRANCH , DELTA NU = 5

V	J = 42	43	44	45	46	47	48
0	13036.87	12769.24	12494.74	12213.23	11924.55	11628.49	11324.84
1	12242.97	11974.48	11698.79	11415.73	11125.12	10826.71	10520.27
2	11444.52	11174.06	10896.04	10610.26	10316.50	10014.52	9704.03
3	10636.75	10363.12	10081.55	9791.80	9493.63	9186.77	8870.90
4	9814.47	9536.44	9250.03	8955.00	8651.08	8337.95	8015.29

V	J = 49
0	11013.33
1	1C205.51
2	9384.73
3	8545.68
4	7682.73

Table 9f. Line Positions of HF, R-Branch, $\Delta v = 6$ Sequence

NU(V,J,+1) , 1/CM , R-BRANCH , DELTA NU = 6

J	v=0	v=1	v=2	v=3
0	21306.29	20331.87	19376.83	18437.01
1	21329.86	20354.25	19398.01	18456.95
2	21344.61	20367.99	19410.69	18468.52
3	21350.50	20373.04	19414.83	18471.66
4	21347.50	20369.40	19410.42	18466.37
5	21335.61	20357.03	19397.44	18452.61
6	21314.82	20335.93	19375.87	18430.38
7	21285.12	20306.40	19345.70	18399.66
8	21246.51	20267.52	19306.93	18360.44
9	21199.01	20220.23	19259.57	18312.73
10	21142.65	20164.22	19203.62	18256.53
11	21077.43	20099.51	19139.10	18191.85
12	21003.40	20026.13	19066.03	18118.70
13	20920.59	19944.12	18984.42	18037.09
14	20829.04	19853.50	18894.32	17947.05
15	20728.30	19754.32	18795.74	17848.60
16	20619.93	19646.62	18688.74	17741.77
17	20502.47	19530.44	18573.32	17626.58
18	20376.50	19405.85	18449.56	17503.07
19	20242.07	19272.88	18317.48	17371.27
20	20099.25	19131.60	18177.14	17231.21
21	19948.12	18982.07	18028.57	17082.92
22	19788.74	18824.35	17871.82	16926.44
23	19621.19	18658.48	17761.95	16761.80
24	19445.54	18484.54	17533.98	16589.03
25	19261.86	18302.58	17352.97	16408.16
26	19070.22	18112.66	17163.96	16219.20
27	18870.70	17914.82	16966.97	16022.19
28	18663.35	17709.12	16762.05	15817.13
29	18448.24	17495.60	16549.23	15604.04
30	18225.43	17274.30	16328.50	15382.91
31	17994.96	17045.25	16099.91	15153.74
32	17756.89	16808.48	15863.43	14916.51
33	17511.24	16563.99	15619.08	14671.20
34	17258.04	16311.80	15366.83	14417.76
35	16997.31	16051.89	15106.65	14156.15
36	16729.05	15784.50	14838.50	13886.29
37	16453.25	15508.85	14562.32	13608.11
38	16169.88	15225.62	14278.04	13321.51
39	15878.91	14934.51	13985.57	13026.37
40	15580.26	14635.43	13684.79	12722.54
41	15273.87	14328.27	13375.56	12409.88

Table 9f. Line Positions of HF, R-Branch, $\Delta v = 6$ Sequence (Continued)

NU(V,J+1), 1/CM, R-BRANCH, DELTA NU = 6

V=	J= 42	43	44	45	46	47	48
0	14959.62	14637.41	14307.07	13968.44	13621.30	13265.43	12900.57
1	14012.91	13689.18	13356.93	13015.93	12665.95	12306.74	11937.98
2	13057.74	12731.14	12395.56	12050.76	11696.47	11332.40	10958.22
3	12088.19	11757.27	11416.88	11066.76	10706.61	10336.10	9954.86

V=	J= 49
0	12526.39
1	11559.35
2	10573.56
3	9562.50

Table 9g. Line Positions of HF, R-Branch, Δv = 7 Sequence

NU(V,J,+1) , 1/CM , R-BRANCH , DELTA NU = 7

J	v=0	v=1	v=2
0	24293.45	23166.24	22059.01
1	24314.29	23185.92	22077.49
2	24324.93	23195.58	22086.11
3	24325.36	23195.22	22084.86
4	24315.54	23184.81	22073.71
5	24295.47	23164.32	22052.64
6	24265.14	23133.77	22021.64
7	24224.56	23093.13	21980.71
8	24173.74	23042.44	21929.85
9	24112.69	22981.68	21869.07
10	24041.44	22910.90	21798.39
11	23960.03	22830.10	21717.82
12	23868.49	22739.33	21627.58
13	23766.87	22638.63	21527.12
14	23655.22	22528.05	21417.05
15	23553.60	22407.57	21297.23
16	23402.06	22277.32	21167.69
17	23260.69	22137.34	21028.47
18	23109.54	21987.37	20879.62
19	22948.69	21828.38	20721.20
20	22778.22	21659.54	20553.26
21	22598.22	21481.21	20375.83
22	22408.45	21293.45	20188.98
23	22209.90	21096.34	19992.76
24	22001.75	20889.93	19787.20
25	21784.38	20674.30	19572.37
26	21557.88	20449.49	19348.30
27	21322.31	20215.56	19115.02
28	21077.75	19972.58	18872.57
29	20824.26	19720.58	18620.98
30	20561.90	19459.59	18360.26
31	20290.73	19189.66	18090.41
32	20010.78	18910.81	17811.45
33	19722.10	18623.03	17523.34
34	19424.71	18326.33	17226.07
35	19118.61	18020.70	16919.59
36	18803.80	17706.10	16603.85
37	18480.26	17382.48	16278.77
38	18147.95	17049.79	15944.25
39	17806.82	16707.92	15600.1F
40	17456.78	16356.78	15246.43
41	17097.74	15996.23	14882.83
42	16729.57	15626.12	14509.19
43	16352.12	15246.27	14125.29
44	15965.21	14856.45	13730.89
45	15568.63	14456.43	13325.72
46	15162.14	14045.92	12909.45
47	14745.46	13624.62	12481.73
48	14318.27	13192.17	12042.19
49	13880.23	12748.18	11590.39

Table 9h. Line Positions of HF, R-Branch, $\Delta v = 8$ Sequence

NU(V,J,+1) , 1/CM , R-BRANCH , DELTA NU = 8

	0	1	2	3	4	5	6
J=	0	1	2	3	4	5	6
V= 0	27127.83	27145.95	27152.53	27147.54	27130.95	27102.75	27062.98
1	25848.42	25865.39	25871.01	25865.25	25848.09	25819.52	25779.54
J=	7	8	9	10	11	12	13
V= 0	27011.60	26948.65	26874.15	26788.12	26690.82	26581.69	26461.37
1	25728.15	25665.36	25591.19	25505.66	25408.82	25300.69	25181.32
J=	14	15	16	17	18	19	20
V= 0	26329.74	26186.85	26032.77	25867.58	25691.36	25504.19	25306.16
1	25050.76	24909.06	24756.28	24592.48	24417.73	24232.10	24035.66
J=	21	22	23	24	25	26	27
V= 0	25097.35	24877.85	24647.75	24407.14	24156.09	23894.71	23623.05
1	23828.47	23610.61	23382.15	23143.16	22893.69	22633.83	22363.61
J=	28	29	30	31	32	33	34
V= 0	23341.20	23049.23	22747.19	22435.14	22113.11	21781.14	21439.24
1	22083.10	21792.33	21491.35	21180.17	20858.82	20527.29	20185.57
J=	35	36	37	38	39	40	41
V= 0	21087.42	20725.64	20353.89	19972.11	19580.22	19178.13	18765.50
1	19833.64	19471.45	19098.93	18715.99	18322.54	17918.43	17503.50
J=	42	43	44	45	46	47	48
V= 0	18342.78	17909.20	17464.73	17009.13	16542.11	16063.34	15572.46
1	17077.57	16640.41	16191.78	15731.39	15258.90	14773.95	14276.14
J=	49						
V= 0	15069.06						
1	13765.01						

Table 9i.   Line Positions of HF, R-Branch, $\Delta v = 9$ Sequence

NU(V,J,+1) , 1/CM , R-BRANCH , DELTA NU = 9

	0	1	2	3	4	5	6
J= 0							
V= 0	29810.00	29825.43	29827.96	29817.56	29794.23	29757.96	29708.75
	0	1	2	3	4	5	6
J= 7							
V= 0	29646.61	29571.57	29483.65	29382.89	29269.34	29143.05	29004.07
	7	8	9	10	11	12	13
J= 14							
V= 0	28852.47	28688.33	28511.72	28322.73	28121.43	27907.92	27682.28
	14	15	16	17	18	19	20
J= 21							
V= 0	27444.61	27195.01	26933.56	26660.36	26375.49	26079.05	25771.10
	21	22	23	24	25	26	27
J= 28							
V= 0	25451.72	25120.99	24778.95	24425.65	24061.13	23685.40	23298.48
	28	29	30	31	32	33	34
J= 35							
V= 0	22900.36	22490.99	22070.34	21638.32	21194.84	20739.77	20272.96
	35	36	37	38	39	40	41
J= 42							
V= 0	19794.23	19303.35	18800.06	18284.09	17755.08	17212.67	16656.43
	42	43	44	45	46	47	48
J= 49							
V= 0	16085.89						

Table 10a. Line Positions of DF, P-Branch, Δv = 1 Sequence

DF

NU(V,J,-1) , 1/CM , P-BRANCH , DELTA NU = 1

V=	J= 1	2	3	4	5	6	7
0	2885.12	2852.82	2839.96	2816.54	2792.58	2768.11	2743.13
1	2794.14	2772.46	2750.19	2727.40	2704.40	2680.26	2655.56
2	2705.07	2683.95	2662.30	2640.13	2617.43	2594.24	2570.87
3	2617.05	2597.21	2576.16	2554.58	2532.50	2509.92	2486.87
4	2530.84	2512.05	2491.62	2470.63	2449.17	2427.17	2404.77
5	2447.09	2428.45	2408.54	2388.12	2367.24	2345.83	2323.47
6	2364.08	2346.08	2326.02	2306.68	2286.95	2265.74	2244.01
7	2283.13	2264.83	2246.72	2226.72	2206.95	2186.54	2166.01
8	2202.07	2184.48	2166.29	2147.46	2128.23	2108.04	2088.40
9	2122.36	2104.85	2087.44	2068.87	2050.58	2031.04	2011.46
10	2042.89	2025.65	2008.44	1990.74	1972.58	1953.97	1934.91
11	1962.80	1946.69	1930.00	1912.83	1895.19	1877.10	1858.57

V=	J= 8	9	10	11	12	13	14
0	2717.66	2691.72	2665.32	2638.47	2611.20	2583.52	2555.44
1	2631.14	2605.87	2580.16	2554.01	2527.44	2500.42	2473.11
2	2546.41	2521.81	2496.76	2471.28	2445.40	2419.12	2392.45
3	2463.36	2439.49	2414.99	2390.17	2364.90	2339.34	2313.36
4	2381.89	2358.49	2334.73	2310.55	2285.97	2261.06	2235.36
5	2301.89	2278.96	2255.81	2232.25	2208.29	2183.96	2159.26
6	2222.76	2200.31	2178.04	2155.17	2131.77	2108.08	2083.59
7	2144.87	2123.31	2101.34	2078.97	2056.21	2033.08	2009.57
8	2067.81	2046.09	2025.42	2003.62	1981.47	1958.88	1935.97
9	1991.42	1970.87	1950.19	1928.86	1907.23	1885.24	1862.88
10	1915.42	1895.51	1875.19	1854.48	1833.37	1811.93	1790.12
11	1839.60	1820.22	1800.42	1780.24	1759.67	1738.74	1717.45

V=	J= 15	16	17	18	19	20	21
0	2526.99	2498.17	2469.01	2439.51	2409.71	2379.60	2349.22
1	2445.38	2417.29	2388.87	2360.12	2331.06	2301.70	2272.07
2	2365.42	2338.05	2310.29	2282.30	2253.39	2225.39	2196.44
3	2287.08	2260.31	2233.60	2205.94	2178.39	2150.34	2122.45
4	2209.81	2183.83	2157.60	2130.94	2103.97	2076.73	2049.21
5	2134.21	2108.83	2083.12	2057.10	2030.79	2004.20	1977.34
6	2059.53	2034.76	2009.68	1984.29	1958.64	1932.88	1906.41
7	1985.76	1961.59	1937.11	1912.31	1887.24	1861.88	1836.25
8	1912.18	1889.12	1865.22	1841.01	1816.51	1791.73	1766.69
9	1840.18	1817.16	1793.81	1770.16	1746.22	1721.99	1697.50
10	1767.96	1745.47	1722.66	1699.55	1676.14	1652.45	1628.50
11	1695.81	1673.84	1651.55	1628.95	1606.06	1582.88	1559.43

Table 10a. Line Positions of DF, P-Branch, Δv = 1 Sequence (Continued)

DF NU(V,J,-1) , 1/CM , P-BRANCH , DELTA NU = 1

V=	J= 22	23	24	25	26	27	28
0	2318.56	2287.66	2256.53	2225.17	2193.62	2161.87	2129.96
1	2242.18	2212.04	2181.67	2151.09	2120.30	2089.33	2058.18
2	2167.28	2137.88	2108.25	2078.41	2048.36	2018.13	1987.73
3	2093.75	2065.06	2036.14	2007.01	1977.67	1948.16	1918.47
4	2021.45	1993.44	1965.20	1936.76	1908.11	1879.28	1850.27
5	1950.23	1922.87	1895.30	1867.51	1839.52	1811.34	1782.99
6	1879.03	1853.26	1826.26	1799.10	1771.60	1744.19	1716.52
7	1810.38	1784.26	1757.91	1731.36	1704.60	1677.65	1650.52
8	1741.39	1715.85	1690.08	1664.10	1637.91	1611.52	1584.96
9	1672.76	1647.77	1622.55	1597.11	1571.47	1545.63	1519.20
10	1604.28	1579.82	1555.12	1530.20	1505.47	1479.74	1454.22
11	1535.72	1511.76	1487.56	1463.13	1438.49	1413.64	1382.59

V=	J= 29	30	31	32	33	34	35
0	2097.88	2065.67	2033.32	2000.87	1968.31	1935.67	1902.96
1	2026.88	1995.47	1963.87	1932.18	1900.39	1868.50	1836.57
2	1957.17	1926.47	1895.64	1864.69	1833.64	1802.50	1771.28
3	1888.62	1858.63	1828.51	1798.02	1767.93	1737.47	1706.98
4	1821.18	1791.80	1762.36	1732.80	1703.19	1673.37	1643.52
5	1754.48	1725.83	1697.03	1668.12	1639.09	1609.96	1580.75
6	1688.58	1660.54	1632.37	1604.06	1575.65	1547.13	1518.63
7	1623.22	1595.78	1568.19	1540.47	1512.05	1484.68	1456.63
8	1558.23	1531.34	1504.31	1477.14	1449.09	1422.43	1394.92
9	1493.40	1467.66	1440.53	1413.87	1387.09	1360.09	1333.17
10	1428.52	1402.66	1376.60	1350.46	1324.15	1297.72	1271.70
11	1363.37	1337.96	1312.40	1286.68	1260.82	1234.82	1208.70

V=	J= 36	37	38	39	40	41	42
0	1870.19	1837.38	1804.54	1771.68	1738.82	1705.97	1673.14
1	1804.56	1772.51	1740.42	1708.31	1676.19	1644.07	1611.97
2	1740.00	1708.67	1677.31	1645.92	1614.50	1583.09	1551.69
3	1675.76	1645.76	1615.08	1584.36	1553.63	1522.89	1492.15
4	1613.60	1583.62	1553.59	1523.52	1493.43	1464.23	1433.22
5	1551.66	1522.05	1492.70	1463.24	1433.76	1404.25	1374.74
6	1489.82	1461.05	1432.23	1403.35	1374.44	1345.50	1316.54
7	1428.50	1400.29	1372.01	1343.68	1315.30	1286.89	1258.45
8	1367.05	1339.62	1311.86	1284.03	1256.45	1228.23	1200.80
9	1306.05	1278.85	1251.56	1224.20	1196.78	1169.31	1141.80
10	1244.51	1217.75	1190.91	1163.98	1136.98	1109.93	1082.81
11	1182.46	1156.11	1129.67	1103.14	1076.53	1049.84	1023.09

Table 10a. Line Positions of DF, P-Branch, $\Delta v = 1$ Sequence (Continued)

DF   NU(V,J,-1) , 1/CM , P-BRANCH , DELTA NU = 1

V=	J= 43	44	45	46	47	48	49	J= 50
0	1640.34	1607.59	1574.89	1542.27	1509.73	1477.28	1444.94	1412.72
1	1579.80	1547.87	1515.89	1483.97	1452.12	1420.36	1388.70	1357.15
2	1520.3	1488.96	1457.65	1426.40	1395.220	1364.11	1333.10	1302.67
3	1461.4	1430.73	1400.07	1369.45	1338.89	1308.40	1277.94	1247.68
4	1403.12	1372.03	1342.98	1312.96	1282.95	1253.08	1223.24	1193.48
5	1345.57	1315.71	1286.23	1253.77	1227.35	1197.99	1168.68	1139.38
6	1287.99	1258.61	1229.65	1200.72	1171.81	1142.95	1114.14	1085.38
7	1229.28	1201.53	1173.06	1144.61	1116.18	1087.79	1059.43	1031.12
8	1172.28	1144.28	1116.27	1081.27	1060.87	1032.30	1004.35	976.45
9	1114.24	1086.67	1059.07	1031.47	1003.87	976.28	948.70	921.02
10	1055.66	1028.46	1001.24	974.00	946.75	919.50	892.25	865.02
11	996.29	969.44	942.55	915.63	888.69	861.74	834.78	807.82

Table 10b. Line Positions of DF, P-Branch, Δv = 2 Sequence

DF   NU(V,J,-1) , 1/CM , P-BRANCH , DELTA NU = 2

V	J=1	2	3	4	5	6	7
0	5700.30	5677.51	5653.48	5628.32	5602.04	5574.66	5546.29
1	5519.77	5497.47	5474.08	5449.58	5424.98	5397.31	5369.57
2	5342.77	5321.11	5298.34	5274.48	5249.55	5223.56	5196.52
3	5169.21	5148.14	5125.98	5102.75	5078.62	5053.13	5026.78
4	4998.76	4978.26	4956.70	4934.08	4910.21	4885.74	4860.00
5	4831.09	4811.16	4790.18	4768.16	4745.17	4721.05	4696.09
6	4665.84	4646.47	4626.05	4604.08	4582.21	4558.72	4534.52
7	4502.65	4483.81	4463.95	4443.14	4421.83	4398.35	4374.29
8	4341.05	4322.76	4303.45	4283.14	4261.83	4239.55	4216.27
9	4180.64	4162.89	4144.12	4124.35	4103.59	4081.86	4059.17
10	4020.95	4003.72	3985.48	3966.24	3946.02	3924.83	3902.69

V	J=8	9	10	11	12	13	14
0	5516.67	5486.10	5454.49	5421.87	5388.26	5353.67	5318.13
1	5340.74	5310.80	5280.16	5248.34	5215.59	5181.80	5147.12
2	5168.42	5139.06	5109.03	5078.24	5046.00	5013.85	4979.96
3	4993.67	4971.06	4941.73	4911.44	4880.20	4848.03	4814.96
4	4833.97	4805.70	4777.07	4747.49	4716.09	4685.57	4653.04
5	4669.88	4642.53	4615.02	4586.14	4556.38	4525.63	4494.04
6	4507.89	4482.99	4455.23	4427.01	4397.88	4367.86	4336.64
7	4349.09	4323.95	4297.32	4269.73	4241.25	4211.28	4181.64
8	4192.09	4166.96	4140.88	4113.90	4086.09	4057.28	4027.66
9	4035.59	4010.96	3985.47	3959.08	3931.79	3903.63	3874.60
10	3879.59	3855.57	3830.64	3804.80	3778.07	3750.46	3721.99

V	J=15	16	17	18	19	20	21
0	5281.65	5244.25	5205.96	5166.79	5126.77	5085.91	5044.23
1	5111.72	5075.06	5037.61	4999.36	4960.97	4921.36	4879.64
2	4944.72	4909.06	4872.54	4835.17	4797.96	4757.96	4718.16
3	4781.00	4746.01	4710.47	4673.94	4636.59	4598.45	4559.52
4	4620.08	4586.27	4554.11	4515.38	4478.84	4441.81	4403.41
5	4462.60	4428.60	4394.16	4359.18	4323.88	4286.84	4249.54
6	4305.20	4272.60	4239.16	4204.92	4169.88	4134.06	4097.47
7	4150.20	4118.60	4085.85	4052.28	4017.93	3982.79	3946.90
8	3997.20	3965.85	3933.77	3900.28	3867.13	3832.64	3797.39
9	3844.73	3814.02	3782.50	3750.17	3717.05	3683.16	3648.51
10	3692.68	3662.53	3631.56	3599.79	3567.23	3533.88	3499.78

Table 10b. Line Positions of DF, P-Branch, $\Delta v = 2$ Sequence (Continued)

DF

NU(V,J,-1) , 1/CM , P-BRANCH , DELTA NU = 2

V	J=22	23	24	25	26	27	28
0	5001.76	4958.52	4914.52	4869.80	4824.36	4778.23	4731.43
1	4938.14	4795.88	4752.87	4709.12	4664.72	4619.61	4573.83
2	4677.58	4636.26	4594.20	4551.35	4507.95	4463.81	4419.00
3	4519.82	4479.95	4438.22	4396.35	4353.78	4310.55	4266.67
4	4364.55	4372.64	4283.64	4243.62	4201.78	4159.51	4116.51
5	4210.44	4172.08	4133.11	4092.04	4052.00	4010.43	3968.36
6	4060.14	4022.00	3983.71	3943.84	3904.68	3862.45	3821.38
7	3910.40	3872.90	3834.82	3796.04	3756.28	3716.79	3675.64
8	3761.40	3724.68	3687.24	3649.107	3610.28	3570.42	3530.84
9	3613.11	3576.98	3540.13	3502.57	3464.27	3425.19	3385.84
10	3464.92	3429.33	3393.02	3355.99	3318.27	3279.87	3240.80

V	J=29	30	31	32	33	34	35
0	4683.99	4635.91	4587.23	4537.96	4488.13	4437.75	4386.84
1	4527.41	4480.37	4432.73	4384.51	4335.79	4286.38	4236.52
2	4373.56	4327.50	4280.71	4233.60	4185.79	4137.45	4088.69
3	4222.14	4177.08	4131.05	4084.26	4038.07	3990.65	3942.69
4	4072.86	4028.58	3983.71	3938.18	3892.20	3845.18	3798.58
5	3925.36	3881.57	3837.55	3793.18	3747.85	3702.19	3655.22
6	3779.26	3736.22	3692.50	3649.18	3604.85	3559.80	3514.22
7	3634.05	3592.43	3549.58	3506.76	3462.47	3418.45	3372.32
8	3489.60	3448.75	3406.24	3363.16	3320.47	3276.79	3232.34
9	3345.67	3304.75	3263.26	3221.16	3178.47	3135.19	3094.34
10	3201.07	3160.70	3119.69	3078.06	3035.83	2992.99	2946.57

V	J=36	37	38	39	40	41	42
0	4335.43	4283.53	4231.16	4178.34	4125.09	4071.43	4017.37
1	4186.11	4135.29	4083.95	4032.18	3979.96	3927.33	3874.29
2	4039.22	3988.30	3938.81	3888.91	3836.54	3785.47	3733.56
3	3894.02	3845.26	3795.81	3745.56	3695.64	3644.47	3593.56
4	3750.09	3702.80	3654.87	3605.17	3555.64	3505.67	3455.28
5	3608.42	3561.70	3514.28	3465.17	3416.60	3367.55	3317.05
6	3468.42	3421.46	3375.46	3326.19	3278.68	3230.00	3181.05
7	3327.72	3281.72	3235.20	3188.19	3140.60	3092.70	3044.05
8	3187.20	3141.72	3096.20	3049.58	3002.60	2955.70	2907.15
9	3046.93	3001.96	2956.46	2910.23	2863.87	2816.81	2769.25
10	2905.57	2861.01	2815.89	2770.23	2724.03	2677.30	2630.05

- 57 -

Table 10b. Line Positions of DF, P-Branch, Δv = 2 Sequence (Continued)

DF $NU(V,J,-1)$, 1/CM , P-BRANCH , DELTA NU = 2

V=	J= 43	44	45	46	47	48	49	J= 50
0	3962.94	3908.15	3853.03	3797.57	3741.81	3685.76	3629.44	3572.85
1	3820.88	3767.09	3712.96	3658.49	3603.70	3548.61	3491.23	3437.57
2	3680.96	3627.80	3574.59	3521.03	3467.14	3412.93	3358.41	3303.64
3	3541.46	3489.97	3437.60	3384.87	3331.80	3278.40	3224.67	3170.8
4	3404.79	3353.25	3301.65	3249.68	3197.35	3144.67	3091.65	3038.22
5	3267.79	3217.28	3166.37	3115.08	3063.40	3011.36	2958.96	2906.22
6	3131.56	3081.67	3031.37	2980.66	2929.56	2878.07	2826.20	2773.97
7	2995.35	2946.00	2896.22	2846.01	2795.39	2744.36	2692.94	2641.13
8	2858.72	2809.82	2760.47	2710.68	2660.45	2609.79	2558.71	2507.47
9	2721.20	2672.66	2623.65	2574.18	2524.25	2473.86	2423.03	2371.77
10	2582.29	2534.02	2485.26	2436.01	2386.28	2336.07	2285.40	2234.25

- 58 -

Table 10c. Line Positions of DF, P-Branch, Δv = 3 Sequence

NU(V,J,-1) , 1/CM , P-BRANCH , DELTA NU = 3

DF

v	J= 1	2	3	4	5	6	7
0	8425.99	8402.54	8377.37	8350.49	8321.93	8291.71	8259.83
1	8157.46	8134.63	8110.12	8083.93	8056.10	8026.63	7995.53
2	7894.24	7872.02	7848.15	7822.64	7795.51	7766.77	7736.43
3	7635.92	7614.98	7591.05	7566.20	7539.87	7511.70	7482.06
4	7382.00	7360.98	7338.34	7314.12	7288.32	7260.96	7232.06
5	7133.34	7111.55	7089.51	7065.90	7040.74	7010.04	6985.80
6	6885.34	6865.09	6843.59	6820.98	6796.44	6770.37	6742.41
7	6641.44	6622.09	6601.20	6578.77	6554.82	6529.36	6502.41
8	6401.63	6382.82	6361.48	6338.62	6315.24	6290.37	6264.05
9	6159.23	6140.96	6121.16	6099.84	6077.03	6052.72	6026.95

v	J= 8	9	10	11	12	13	14
0	8226.32	8191.20	8154.49	8116.21	8076.37	8035.01	7992.14
1	7962.80	7928.57	7892.73	7855.35	7816.44	7776.03	7734.15
2	7704.55	7671.06	7636.06	7599.55	7561.53	7522.06	7481.09
3	7450.95	7418.27	7384.07	7348.38	7311.22	7272.60	7232.34
4	7201.60	7169.77	7136.18	7101.07	7065.03	7027.24	6988.03
5	6956.44	6924.80	6892.18	6858.07	6822.45	6785.44	6747.04
6	6713.74	6683.20	6651.27	6617.02	6582.92	6546.28	6509.09
7	6473.30	6444.10	6414.24	6380.77	6345.84	6310.28	6273.39
8	6236.21	6206.03	6176.24	6144.19	6110.57	6075.67	6039.38
9	5999.71	5971.03	5940.92	5909.39	5876.47	5842.16	5806.48

v	J= 15	16	17	18	19	20	21
0	7947.78	7901.96	7854.71	7806.04	7755.98	7704.56	7651.80
1	7690.80	7646.02	7599.82	7552.23	7503.28	7452.98	7401.36
2	7438.18	7394.91	7349.97	7303.16	7255.25	7206.01	7155.47
3	7190.04	7148.21	7103.97	7058.38	7011.44	6963.23	6913.71
4	6947.25	6905.45	6862.11	6817.43	6771.44	6724.15	6675.58
5	6709.03	6666.61	6623.60	6579.78	6534.66	6488.25	6440.58
6	6469.03	6429.10	6387.40	6344.88	6300.75	6254.71	6208.12
7	6235.07	6195.38	6154.40	6112.12	6068.55	6023.81	5977.61
8	5999.45	5962.77	5921.46	5880.86	5837.97	5793.81	5748.39
9	5769.45	5731.08	5691.40	5650.41	5608.14	5564.59	5519.79

v	J= 22	23	24	25	26	27	28
0	7597.72	7542.35	7485.72	7427.86	7368.71	7308.51	7247.08
1	7348.66	7294.25	7238.82	7182.16	7124.31	7065.28	7005.10
2	7103.71	7050.58	6996.28	6940.76	6884.06	6826.20	6767.20
3	6862.77	6810.50	6757.65	6703.20	6647.59	6590.11	6532.00
4	6625.66	6574.72	6522.65	6469.64	6414.39	6358.62	6301.73
5	6391.60	6341.52	6290.17	6237.62	6183.47	6129.10	6073.15
6	6160.03	6110.72	6060.21	6008.05	5955.85	5901.72	5846.35
7	5930.28	5881.72	5831.98	5780.95	5728.95	5675.57	5621.35
8	5701.17	5653.88	5604.81	5554.56	5503.14	5450.57	5396.87
9	5473.75	5426.49	5378.02	5328.37	5277.54	5225.55	5172.42

Table 10c. Line Positions of DF, P-Branch, $\Delta v = 3$ Sequence (Continued)

DF

NU(V,J,-1) , 1/CM , P-BRANCH , DELTA NU = 3

V=	J= 29	30	31	32	33	34	35
0	7184.52	7120.85	7056.10	6990.29	6923.47	6855.61	6786.79
1	6947.81	6881.41	6817.94	6753.42	6687.87	6621.32	6553.80
2	6707.08	6645.87	6583.60	6520.28	6455.19	6390.59	6324.28
3	6473.77	6413.79	6352.62	6290.41	6225.17	6162.96	6091.73
4	6246.03	6184.65	6124.51	6063.25	6001.16	5937.90	5873.70
5	6016.01	5957.92	5898.71	5838.45	5777.14	5714.86	5651.58
6	5790.38	5733.02	5674.67	5615.06	5554.74	5493.26	5430.67
7	5565.88	5509.31	5451.67	5392.96	5333.22	5272.45	5210.67
8	5342.05	5286.13	5229.13	5171.06	5111.93	5051.76	4990.56
9	5118.16	5062.79	5006.32	4948.77	4890.14	4830.47	4769.75

V=	J= 36	37	38	39	40	41	42
0	6717.01	6646.31	6574.70	6502.21	6428.86	6354.68	6279.69
1	6480.32	6415.80	6345.60	6274.40	6202.35	6129.45	6055.73
2	6257.05	6188.02	6118.68	6049.68	5978.81	5907.09	5834.61
3	6031.42	5964.48	5896.47	5827.55	5757.66	5687.11	5615.72
4	5808.07	5742.44	5675.42	5607.48	5538.66	5468.96	5398.30
5	5567.33	5522.04	5455.52	5388.91	5320.94	5252.08	5182.362
6	5367.36	5302.14	5237.52	5171.24	5108.21	5035.59	4966.82
7	5147.28	5084.16	5020.97	4953.74	4887.13	4810.09	4751.14
8	4928.66	4865.16	4800.97	4735.81	4669.69	4602.62	4534.61
9	4707.09	4645.22	4581.45	4516.67	4450.91	4384.18	4316.18

V=	J= 43	44	45	46	47	48	49
0	6203.92	6127.38	6050.10	5972.09	5893.39	5814.01	5733.96
1	5981.22	5906.93	5829.18	5753.15	5675.62	5597.42	5518.54
2	5761.80	5687.04	5612.12	5536.45	5460.05	5382.99	5305.108
3	5543.07	5470.18	5396.28	5322.12	5246.15	5169.04	5093.93
4	5327.07	5254.82	5181.00	5107.02	5032.15	4958.04	4881.04
5	5111.03	5040.35	4968.09	4895.06	4821.76	4746.48	4671.65
6	4896.79	4826.15	4754.65	4682.06	4608.76	4534.65	4459.72
7	4681.67	4611.54	4540.05	4468.42	4395.57	4321.86	4247.05
8	4465.67	4395.82	4325.05	4253.39	4180.82	4107.38	4033.05
9	4247.83	4178.22	4107.67	4036.19	3963.77	3890.43	3816.18

V=	J= 50
0	5653.27
1	5439.01
2	5226.547
3	5015.08
4	4805.08
5	4594.98
6	4383.98
7	4171.91
8	3957.84
9	3741.00

Table 10d. Line Positions of DF, P-Branch, $\Delta v = 4$ Sequence

DF   NU(V,J,-1) , 1/CM , P-BRANCH , DELTA NU = 4

V=	J=1	2	3	4	5	6	7
0	11563.71	11039.69	11013.40	10984.85	10954.05	10921.02	10885.79
1	10708.93	10685.55	10659.93	10632.10	10602.06	10569.83	10535.44
2	10360.95	10338.01	10313.23	10286.23	10256.79	10225.33	10191.75
3	10019.17	9997.01	9972.70	9946.23	9917.64	9886.92	9854.12
4	9682.93	9661.36	9637.64	9611.86	9583.95	9553.95	9521.88
5	9351.51	9330.53	9308.53	9282.66	9255.69	9225.69	9194.39
6	9024.15	9003.73	8981.22	8956.66	8930.04	8901.19	8870.64
7	8700.01	8680.15	8658.23	8634.24	8608.23	8580.19	8550.14
8	8378.21	8358.89	8337.52	8314.11	8288.68	8261.24	8231.80

V=	J=8	9	10	11	12	13	14
0	10848.37	10808.79	10767.06	10723.21	10677.29	10629.24	10579.17
1	10498.06	10460.27	10419.47	10376.61	10331.11	10284.73	10235.76
2	10156.23	10118.28	10078.41	10036.50	9992.56	9946.71	9898.68
3	9819.23	9782.28	9743.28	9702.80	9659.26	9614.27	9567.32
4	9487.90	9451.64	9413.44	9373.48	9334.07	9287.24	9241.08
5	9160.14	9125.32	9088.16	9048.16	9007.48	8962.05	8919.08
6	8838.00	8803.10	8766.66	8728.06	8687.51	8645.67	8600.70
7	8518.11	8484.10	8448.13	8410.23	8370.46	8328.61	8285.06
8	8200.13	8167.01	8131.68	8094.43	8055.26	8014.20	7971.26

V=	J=15	16	17	18	19	20	21
0	10527.97	10472.98	10416.00	10358.24	10298.99	10237.18	10173.52
1	10184.79	10131.87	10077.00	10020.22	9961.55	9901.63	9838.52
2	9848.74	9797.65	9743.27	9687.64	9630.44	9570.87	9509.67
3	9518.65	9467.65	9414.59	9360.44	9304.06	9245.57	9185.85
4	9193.10	9143.28	9090.34	9036.05	8982.19	8925.17	8866.22
5	8872.03	8823.11	8772.34	8714.05	8665.35	8609.17	8551.22
6	8554.57	8506.38	8456.46	8404.72	8350.19	8294.87	8238.83
7	8239.57	8192.25	8143.09	8092.13	8039.39	7984.87	7928.61
8	7926.46	7879.83	7831.36	7781.10	7729.05	7675.24	7619.68

V=	J=22	23	24	25	26	27	28
0	10108.02	10040.73	9971.67	9900.87	9828.37	9754.18	9678.35
1	9774.76	9708.58	9640.90	9571.50	9507.50	9427.46	9353.30
2	9446.14	9381.60	9315.48	9247.60	9177.86	9106.46	9032.44
3	9124.14	9060.60	8995.48	8928.75	8866.07	8787.90	8718.12
4	8806.55	8743.60	8679.51	8613.75	8546.93	8477.30	8406.16
5	8491.55	8430.15	8367.07	8302.32	8235.93	8166.91	8098.30
6	8180.04	8119.55	8057.07	7993.04	7928.04	7860.50	7792.59
7	7870.62	7810.93	7749.55	7686.04	7621.82	7555.50	7487.59
8	7562.39	7503.39	7442.71	7380.35	7316.35	7250.71	7183.45

Table 10d. Line Positions of DF, P-Branch, $\Delta r = 4$ Sequence (Continued)

CF

NU(V,J,J-1) , 1/CM , P-BRANCH , DELTA NU = 4

V=	J= 29	30	31	32	33	34	35
0	9600.91	9521.88	9441.30	9359.20	9275.61	9190.55	9104.07
1	9277.33	9199.78	9120.69	9040.17	8958.05	8874.47	8789.51
2	8958.83	8882.66	8804.95	8725.47	8645.05	8562.90	8479.38
3	8644.77	8569.86	8493.42	8416.59	8336.31	8255.18	8172.88
4	8341.45	8266.68	8185.39	8108.59	8030.35	7950.57	7869.41
5	8027.14	7954.37	7880.72	7804.32	7727.05	7650.38	7568.14
6	7721.08	7650.10	7576.72	7501.83	7425.44	7347.58	7268.25
7	7418.08	7347.01	7274.40	7200.26	7124.60	7047.46	6968.84
8	7114.60	7044.18	6972.19	6898.66	6823.60	6747.03	6668.97

V=	J= 36	37	38	39	40	41	42
0	9016.19	8926.93	8836.34	8744.43	8651.24	8556.80	8461.13
1	8703.15	8615.41	8526.34	8435.95	8344.27	8251.33	8157.59
2	8393.17	8308.08	8220.34	8131.82	8041.078	7949.40	7856.76
3	8089.17	8004.08	7917.64	7829.83	7740.78	7650.440	7558.70
4	7786.82	7702.85	7617.52	7530.83	7442.82	7353.50	7262.89
5	7487.69	7403.55	7319.16	7230.41	7146.43	7057.90	6968.16
6	7187.94	7105.31	7021.73	6936.76	6850.43	6762.74	6673.710
7	6888.77	6807.25	6724.32	6639.97	6554.22	6467.09	6378.59
8	6589.42	6508.41	6425.95	6342.05	6256.73	6169.99	6081.84

V=	J= 43	44	45	46	47	48	49
0	8364.26	8266.22	8167.03	8066.72	7965.31	7862.82	7759.28
1	8061.75	7965.17	7867.43	7768.54	7668.53	7567.42	7465.23
2	7761.53	7667.25	7570.80	7473.18	7374.41	7274.31	7173.517
3	7465.87	7371.75	7276.42	7179.90	7082.21	6983.36	6883.37
4	7171.01	7077.88	6983.52	6887.93	6791.15	6693.06	6594.04
5	6877.13	6784.82	6691.45	6596.442	6500.94	6403.16	6304.54
6	6583.35	6491.69	6398.720	6304.47	6208.94	6112.14	6014.08
7	6288.74	6197.54	6105.07	6011.13	5915.94	5819.44	5721.64
8	5992.30	5901.37	5809.07	5715.39	5620.35	5523.95	5426.19

V=	J= 50
0	7654.71
1	7361.98
2	7071.44
3	6782.25
4	6493.67
5	6204.82
6	5914.76
7	5627.57
8	5327.07

Table 10e. Line Positions of DF, P-Branch, Δv = 5 Sequence

DF   NU(V,J-1) , 1/CM , P-BRANCH , DELTA NU = 5

J = 1 to 7

v	J=1	J=2	J=3	J=4	J=5	J=6	J=7
0	13615.18	13590.61	13563.01	13533.95	13500.94	13464.23	13425.70
1	13475.63	13451.71	13425.01	13395.95	13363.68	13028.56	13490.76
2	13344.20	13272.90	12694.87	12666.97	12634.68	12600.91	12563.77
3	13302.43	12272.40	12272.60	12243.22	12621.60	12179.60	12143.93
4	11490.31	11880.35	11444.68	11828.22	11798.21	11765.70	11773.22
5	11082.73	11468.81	11038.26	11412.14	11388.45	11356.70	11322.42
6	10678.60	11061.79	10635.26	11017.12	10918.89	10918.93	10918.89
7		10658.22	10403.58	10609.74	10581.66	10551.05	10517.92

J = 8 to 14

v	J=8	J=9	J=10	J=11	J=12	J=13	J=14
0	13386.44	13340.46	13293.80	13244.47	13192.51	13137.94	13080.78
1	13950.43	12907.46	12865.81	12811.56	12762.51	12709.30	12653.45
2	12524.35	12482.28	12437.62	12390.17	12340.60	12288.28	12233.32
3	12050.61	12064.18	12026.42	11974.07	11921.37	11874.85	11818.07
4	11692.20	11652.66	11620.42	11564.08	11512.08	11465.85	11410.78
5	11285.20	11245.66	11203.02	11159.08	11112.08	11062.64	11016.42
6	10882.29	10844.31	10803.02	10758.27	10715.07	10267.20	10216.93
7	10482.29	10444.17	10403.58	10360.54	10315.08	10267.20	10216.93

J = 15 to 21

v	J=15	J=16	J=17	J=18	J=19	J=20	J=21
0	13021.87	12958.82	12894.90	12826.90	12757.27	12685.23	12610.83
1	12476.15	12116.40	12054.22	12046.66	12336.42	12265.81	12610.87
2	12176.18	12116.40	12054.22	11989.65	11922.71	11853.43	11781.85
3	11764.80	11705.48	11644.46	11581.06	11515.30	11447.28	11376.95
4	11357.20	11357.23	11246.05	11159.02	11115.07	11065.48	10977.30
5	10956.02	10899.88	10804.05	10779.58	10715.02	10650.08	10589.83
6	10164.29	10503.25	10045.15	10384.73	10322.02	10257.05	10189.89
7	10164.29	10164.31	10051.99	09992.37	09930.47	09866.30	09799.89

J = 22 to 28

v	J=22	J=23	J=24	J=25	J=26	J=27	J=28
0	12534.09	12455.06	12373.75	12290.26	12204.48	12116.58	12026.55
1	12176.15	11631.87	11960.53	11878.36	11390.34	11407.93	11618.54
2	11707.69	11631.87	11553.53	11473.02	11390.12	11305.57	11218.66
3	11305.36	11229.23	11152.51	11073.34	10992.30	10908.57	10823.05
4	10905.56	10838.28	10756.41	10687.43	10505.30	10526.17	10431.82
5	10511.39	10048.75	10376.94	10287.99	10208.90	10127.72	10045.46
6	10120.26	10048.75	09974.94	09898.99	09820.90	09740.72	09658.46
7	09731.26	09660.44	09587.44	09512.30	09435.02	09355.64	09274.17

J = 29 to 35

v	J=29	J=30	J=31	J=32	J=33	J=34	J=35
0	11934.43	11840.26	11744.06	11645.88	11545.75	11443.71	11339.78
1	11529.07	11436.56	11342.05	11245.56	11147.12	11046.78	10944.57
2	11035.70	10645.72	10945.74	10850.04	10753.25	10267.86	10168.58
3	10345.48	10257.13	10166.78	10074.46	09980.25	10267.03	09405.62
4	09658.73	09874.81	09782.19	09690.94	09980.75	09884.03	09405.62
5	09574.15	09874.81	09782.19	09399.46	09216.83	09502.64	09026.43
6	09190.63	09105.06	09017.46	08927.86	08836.28	08742.73	08647.25
7							

Table 10e. Line Positions of DF, P-Branch, Δv = 5 Sequence (Continued)

DF   NU(V,J,-1) , 1/CM , P-BRANCH , DELTA NU = 5

V	J= 36	37	38	39	40	41	42
0	11234.01	11126.43	11017.08	10905.98	10793.17	10678.68	10562.55
1	10840.51	10734.64	10626.99	10517.59	10406.47	10293.67	10179.20
2	10451.95	10347.62	10241.51	10133.64	10024.03	9912.72	9799.74
3	10067.45	9964.28	9859.74	9753.21	9644.94	9536.94	9423.29
4	9686.05	9584.28	9480.71	9375.34	9268.20	9159.31	9049.05
5	9306.72	9206.96	9103.37	8998.90	8892.72	8784.79	8675.05
6	8928.37	8828.43	8726.63	8622.90	8517.52	8410.24	8301.16
7	8549.83	8450.51	8349.30	8246.21	8141.26	8034.46	7925.83

V	J= 43	44	45	46	47	48	49
0	10444.80	10325.46	10204.57	10082.14	9958.22	9832.81	9705.96
1	10063.10	9945.39	9826.10	9705.26	9582.89	9459.00	9333.64
2	9685.09	9568.82	9450.94	9331.48	9210.96	9087.89	8963.79
3	9309.85	9194.82	9078.14	8959.85	8839.96	8718.48	8595.43
4	8936.77	8822.36	8706.67	8589.33	8470.35	8349.74	8227.50
5	8563.57	8450.36	8335.45	8218.08	8100.53	7980.55	7858.90
6	8190.31	8077.68	7963.30	7847.18	7729.37	7609.73	7488.41
7	7815.37	7703.09	7589.01	7473.14	7355.47	7236.01	7114.78

V	J= 50
0	9577.68
1	9206.80
2	8838.19
3	8470.68
4	8103.60
5	7735.38
6	7365.38
7	6991.76

Table 10f. Line Positions of DF, P-Branch, $\Delta v = 6$ Sequence

DF   NU(V,J,-1) , 1/CM , P-BRANCH , DELTA NU = 6

V	J=1	J=2	J=3	J=4	J=5	J=6	J=7
0	16081.89	16056.78	16028.30	15996.46	15961.29	15922.80	15881.02
1	15558.88	15534.42	15506.20	15475.58	15441.23	15403.63	15362.78
2	15045.10	15021.29	14994.20	14963.87	14930.31	14893.54	14852.44
3	14539.59	14516.38	14489.96	14460.34	14427.53	14391.60	14352.42
4	14041.23	14018.63	13992.85	13963.90	13931.82	13896.52	13858.28
5	13548.89	13526.87	13501.71	13473.42	13442.02	13407.52	13369.05
6	13061.31	13039.86	13015.30	12987.63	12956.88	12923.07	12886.20

V	J=8	J=9	J=10	J=11	J=12	J=13	J=14
0	15835.97	15787.67	15736.14	15681.42	15623.53	15562.50	15498.36
1	15318.71	15271.45	15221.02	15167.44	15110.75	15050.97	14988.12
2	14810.45	14764.18	14714.78	14662.28	14606.47	14548.09	14486.57
3	14310.87	14264.85	14216.42	14164.90	14110.31	14052.88	13992.37
4	13816.87	13772.40	13724.87	13674.32	13620.77	13564.25	13504.77
5	13329.30	13287.68	13242.96	13189.26	13136.64	13081.03	13022.50
6	12846.29	12803.38	12757.47	12708.58	12656.74	12601.98	12544.30

V	J=15	J=16	J=17	J=18	J=19	J=20	J=21
0	15431.14	15360.36	15287.60	15211.34	15132.12	15050.02	14965.03
1	14922.62	14854.23	14783.50	14706.71	14623.98	14548.45	14465.91
2	14420.27	14354.23	14283.71	14210.28	14133.98	14054.85	13972.60
3	13928.87	13867.50	13793.28	13724.03	13646.02	13566.20	13487.60
4	13442.06	13389.75	13308.59	13259.60	13164.02	13087.39	13008.00
5	12961.03	12896.75	12829.59	12759.60	12686.80	12611.24	12532.93
6	12483.73	12420.31	12354.05	12284.97	12213.10	12138.48	12061.11

V	J=22	J=23	J=24	J=25	J=26	J=27	J=28
0	14877.20	14786.57	14693.18	14597.07	14498.28	14396.84	14292.79
1	14378.84	14289.86	14198.16	14103.76	14006.70	13907.02	13804.76
2	13888.25	13804.74	13700.53	13617.02	13522.00	13424.37	13323.58
3	13404.25	13318.06	13229.43	13138.02	13047.00	12947.37	12848.10
4	12925.88	12841.06	12753.57	12663.44	12570.69	12475.37	12377.49
5	12451.90	12368.18	12281.80	12194.79	12101.16	12006.95	11910.04
6	11981.03	11898.26	11812.84	11724.78	11634.11	11540.85	11445.04

V	J=29	J=30	J=31	J=32	J=33	J=34	J=35
0	14186.15	14077.04	13965.84	13851.34	13734.86	13616.01	13494.84
1	13699.65	13592.63	13482.84	13370.34	13255.99	13139.07	13019.65
2	13220.42	13114.75	13006.62	12896.07	12783.14	12667.80	12550.16
3	12746.52	12642.33	12535.87	12426.09	12315.40	12201.31	12085.44
4	12277.10	12174.21	12068.87	11961.09	11850.93	11738.35	11623.44
5	11810.93	11709.16	11604.92	11498.24	11389.14	11277.65	11163.79
6	11346.70	11245.85	11142.52	11036.73	10928.50	10817.86	10704.83

Table 10f. Line Positions of DF, P-Branch, $\Delta v = 6$ Sequence (Continued)

DF   NU(V,J,-1) , 1/CM , P-BRANCH , DELTA NU = 6

V=	J= 36	37	38	39	40	41	42
0	13371.38	13245.66	13117.73	12987.62	12855.37	12721.02	12584.60
1	12898.09	12774.24	12648.17	12519.91	12389.49	12256.96	12122.34
2	12430.23	12308.04	12183.61	12056.99	11928.19	11797.26	11664.21
3	11966.67	11845.92	11722.93	11597.72	11470.32	11340.75	11209.04
4	11506.22	11386.70	11264.92	11140.89	11014.64	10886.20	10755.58
5	11047.60	10929.08	10808.27	10685.19	10559.86	10432.29	10302.50
6	10589.43	10471.69	10351.62	10229.23	10104.56	09977.61	09848.39

V=	J= 43	44	45	46	47	48	49
0	12446.14	12305.68	12163.24	12018.86	11872.58	11724.40	11574.37
1	11985.66	11846.96	11706.25	11563.56	11418.93	11272.38	11123.92
2	11529.08	11391.89	11252.66	11111.43	10968.20	10823.00	10675.86
3	11075.21	10939.29	10801.50	10661.25	10519.16	10375.06	10228.95
4	10622.81	10487.90	10350.87	10211.74	10070.52	9927.23	9781.88
5	10170.52	10036.36	9900.03	9761.54	9620.90	9478.14	9333.24
6	9716.93	9583.24	9447.32	9309.11	9168.84	9026.30	8881.55

V=	J= 50
0	11422.50
1	10973.58
2	10526.76
3	10080.85
4	9634.47
5	9186.22
6	8734.61

Table 10g. Line Positions of DF, P-Branch, Δv = 7 Sequence

NU(V,J,J-1) , 1/CM , P-BRANCH , DELTA NU = 7

CF

V=	J= 1	J= 2	J= 3	J= 4	J= 5	J= 6	J= 7
0	18465.13	18439.49	18409.94	18376.50	18339.19	18298.03	18253.04
1	17859.80	17834.81	17805.98	17773.32	17736.86	17696.61	17652.09
2	17264.66	17240.27	17212.14	17180.02	17144.13	17105.19	17062.03
3	16678.39	16654.66	16627.20	16596.02	16561.23	16522.57	16480.33
4	16099.81	16076.69	16049.87	16019.38	15985.23	15947.43	15906.01
5	15527.48	15504.94	15478.75	15448.91	15415.45	15378.38	15337.73

V=	J= 8	J= 9	J= 10	J= 11	J= 12	J= 13	J= 14
0	18204.25	18151.68	18095.35	18035.34	17971.57	17904.17	17833.14
1	17597.83	17553.35	17498.18	17439.34	17376.86	17310.78	17241.12
2	17015.30	16964.97	16910.88	16853.05	16791.75	16726.89	16658.50
3	16434.46	16384.97	16311.88	16275.21	16215.01	16151.28	16084.06
4	15860.99	15812.39	15760.23	15704.56	15645.33	15582.64	15516.49
5	15293.50	15245.72	15194.42	15139.60	15081.31	15019.56	14954.38

V=	J= 15	J= 16	J= 17	J= 18	J= 19	J= 20	J= 21
0	17758.51	17680.32	17598.60	17513.39	17424.73	17332.65	17237.20
1	17167.61	17091.14	17010.45	16926.74	16840.29	16750.76	16656.11
2	16586.61	16511.24	16432.45	16350.24	16264.67	16175.76	16083.56
3	16013.08	15939.27	15861.57	15780.05	15696.06	15609.11	15519.00
4	15447.01	15374.63	15289.57	15209.87	15134.56	15048.56	14959.00
5	14885.78	14813.81	14738.49	14659.84	14577.89	14492.67	14404.21

V=	J= 22	J= 23	J= 24	J= 25	J= 26	J= 27	J= 28
0	17138.42	17036.34	16931.01	16822.47	16710.76	16595.92	16478.01
1	16559.08	16458.74	16355.21	16248.49	16138.64	16025.70	15909.69
2	15988.00	15889.38	15787.49	15682.44	15574.27	15463.03	15348.74
3	15424.26	15327.01	15226.59	15123.03	15016.37	14906.64	14793.89
4	14866.23	14770.26	14671.14	14568.58	14463.56	14355.16	14243.73
5	14312.55	14217.70	14119.70	14018.58	13914.37	13807.09	13696.79

V=	J= 29	J= 30	J= 31	J= 32	J= 33	J= 34	J= 35
0	16357.05	16233.11	16106.21	15976.40	15843.73	15708.24	15569.97
1	15790.65	15668.66	15543.72	15415.88	15285.19	15151.68	15015.40
2	15231.13	15111.20	14988.01	14861.94	14733.01	14601.26	14466.78
3	14678.13	14559.42	14437.78	14313.24	14185.85	14055.63	13922.89
4	14129.31	14011.92	13891.48	13768.38	13642.36	13513.36	13381.62
5	13583.48	13467.20	13347.98	13225.84	13100.81	12972.92	12842.19

V=	J= 36	J= 37	J= 38	J= 39	J= 40	J= 41	J= 42
0	15428.96	15285.26	15138.90	14989.94	14838.39	14684.32	14527.74
1	14876.37	14734.67	14590.26	14443.25	14293.65	14141.49	13986.82
2	14329.45	14189.47	14046.80	13901.49	13753.57	13603.07	13450.02
3	13786.66	13648.34	13507.14	13363.27	13216.76	13067.64	12915.93
4	13247.10	13110.82	12969.82	12827.11	12681.78	12533.70	12383.04
5	12708.66	12572.34	12433.26	12291.44	12146.90	11999.66	11849.74

Table 10g.   Line Positions of DF, P-Branch, Δv = 7 Sequence (Continued)

DF   NU(V,J,-1) , 1/CM , P-BRANCH , DELTA NU = 7

V=	J= 43	J= 44	J= 45	J= 46	J= 47	J= 48	J= 49	J= 50
0	14368.71	14207.24	14043.39	13877.17	13708.62	13537.78	13364.65	13189.28
1	13829.65	13670.02	13507.97	13343.51	13176.68	13007.50	12835.99	12662.17
2	13294.44	13136.36	12975.82	12812.83	12647.41	12479.58	12309.37	12136.79
3	12761.65	12604.83	12445.49	12283.66	12119.34	11952.55	11783.31	11611.63
4	12229.76	12073.89	11915.45	11754.45	11590.9C	11424.82	11256.21	11085.08
5	11697.15	11541.91	11384.04	11223.55	11060.43	10894.71	10726.38	10555.45

-68-

Table 10h. Line Positions of DF, P-Branch, Δv = 5 Sequence

NU(V,J,-1) , 1/CM , P-BRANCH , DELTA NU = 8

CF

v	J=1	J=2	J=3	J=4	J=5	J=6	J=7
0	20766.05	20739.88	20709.27	20674.24	20634.81	20591.04	20542.85
1	20079.52	20053.79	20023.91	19989.69	19951.13	19908.20	19861.10
2	19403.42	19378.55	19349.38	19315.91	19278.14	19236.20	19189.99
3	18736.96	18712.72	18684.22	18651.49	18614.54	18573.39	18528.06
4	18078.39	18054.76	18026.91	17994.87	17958.66	17918.29	17873.79

v	J=8	J=9	J=10	J=11	J=12	J=13	J=14
0	20490.36	20433.58	20372.51	20307.21	20237.68	20163.98	20086.14
1	19809.68	19754.07	19694.16	19630.11	19561.90	19489.57	19413.16
2	19139.57	19084.97	19026.21	18963.33	18896.34	18825.29	18750.19
3	18478.58	18424.95	18367.24	18305.43	18239.56	18169.67	18095.78
4	17825.17	17772.46	17715.68	17654.85	17590.01	17521.17	17448.37

v	J=15	J=16	J=17	J=18	J=19	J=20	J=21
0	20004.18	19918.15	19828.08	19734.02	19636.00	19534.07	19428.25
1	19332.69	19248.20	19159.73	19067.31	18970.98	18870.78	18766.75
2	18671.09	18588.02	18501.00	18410.88	18315.29	18216.27	18114.26
3	18017.93	17936.14	17850.44	17760.38	17667.48	17560.27	17469.30
4	17371.63	17290.99	17206.47	17118.11	17025.94	16929.99	16830.29

v	J=22	J=23	J=24	J=25	J=26	J=27	J=28
0	19318.63	19205.21	19088.06	18967.20	18842.70	18714.60	18582.94
1	18658.94	18547.38	18432.11	18313.18	18190.63	18064.50	17934.85
2	18008.09	17898.21	17784.64	17667.44	17546.43	17422.29	17294.42
3	17364.60	17256.99	17144.16	17028.49	16909.23	16786.43	16660.30
4	16726.87	16619.78	16509.04	16394.69	16276.76	16155.29	16030.31

v	J=29	J=30	J=31	J=32	J=33	J=34	J=35
0	18447.70	18309.10	18167.09	18021.67	17872.93	17720.92	17565.96
1	17801.07	17665.10	17525.11	17381.75	17235.08	17085.14	16931.06
2	17163.09	17028.10	16890.10	16748.56	16607.71	16455.58	16304.20
3	16530.34	16399.12	16260.51	16120.53	15977.23	15830.64	15680.02
4	15901.86	15769.96	15634.66	15495.98	15353.96	15208.63	15060.02

v	J=36	J=37	J=38	J=39	J=40	J=41	J=42
0	17407.24	17245.67	17081.00	16913.28	16742.55	16568.85	16392.22
1	16775.63	16616.88	16453.46	16287.76	16119.00	15947.31	15772.60
2	16149.63	15991.08	15831.01	15667.05	15500.02	15329.96	15156.90
3	15529.96	15371.46	15212.04	15049.50	14883.85	14715.14	14543.38
4	14908.16	14753.08	14594.80	14433.36	14268.77	14101.07	13930.27

Table 10h. Line Positions of DF, P-Branch, $\Delta v = 8$ Sequence (Continued)

DF   NU(V,J-1) , 1/CM , P-BRANCH , DELTA NU = 8

V=	J= 43	44	45	46	47	48	49
0	16212.69	16030.31	15845.11	15657.12	15466.37	15272.89	15076.72
1	15595.01	15414.50	15231.12	15044.91	14855.88	14664.07	14469.50
2	14980.87	14801.90	14620.02	14435.23	14247.58	14057.07	13863.73
3	14368.60	14190.83	14010.07	13826.36	13639.71	13450.44	13257.64
4	13756.39	13579.45	13399.47	13216.46	13030.43	12841.39	12649.35

V=	J= 50
0	14877.87
1	14272.18
2	13667.57
3	13062.25
4	12454.31

Table 10i. Line Positions of DF, P-Branch, Δv = 9 Sequence

DF   NU(V,J,-1) , 1/CM , P-BRANCH , DELTA NU = 9

J	v=0	v=1	v=2	v=3
1	22985.56	22218.10	21461.99	20715.55
2	22958.86	22192.07	21436.61	20690.79
3	22927.20	22161.15	21406.40	20661.27
4	22890.60	22125.37	21371.39	20626.99
5	22849.08	22084.73	21331.59	20587.98
6	22802.66	22039.27	21287.02	20544.26
7	22751.36	21987.00	21237.72	20495.84
8	22695.22	21933.95	21183.69	20442.76
9	22634.25	21874.14	21124.96	20385.03
10	22568.49	21809.61	21061.57	20322.68
11	22497.97	21740.39	20993.54	20255.74
12	22422.72	21566.50	20920.90	20184.24
13	22342.78	21587.98	20843.68	20108.20
14	22258.18	21504.86	20761.92	20027.66
15	22168.96	21417.18	20675.64	19942.65
16	22075.16	21324.97	20584.89	19853.20
17	21976.82	21228.28	20489.69	19759.34
18	21873.98	21127.14	20390.09	19661.12
19	21766.69	21021.60	20286.13	19558.56
20	21654.98	20911.69	20177.84	19451.70
21	21538.91	20797.46	20065.26	19340.59
22	21418.65	20678.26	19948.44	19225.25
23	21293.85	20555.20	19827.41	19105.72
24	21164.27	20429.29	19702.22	18982.06
25	21030.89	20298.19	19572.90	18854.28
26	20894.80	20163.77	19439.51	18722.44
27	20753.77	20023.74	19302.08	18586.56
28	20608.59	19879.52	19160.65	18446.70
29	20458.80	19733.31	19015.28	18302.89
30	20305.58	19582.19	18865.99	18155.16
31	20148.48	19427.20	18712.84	18003.57
32	19987.54	19268.38	18555.86	17848.13
33	19822.82	19105.79	18395.09	17688.90
34	19654.37	18939.46	18230.59	17525.91
35	19482.23	18769.44	18062.38	17359.19
36	19306.46	18595.77	17890.50	17188.79
37	19127.10	18418.50	17715.00	17014.72
38	18944.19	18237.67	17535.91	16837.03
39	18757.79	18053.31	17353.27	16655.74
40	18567.93	17865.48	17167.11	16470.89
41	18374.20	17674.20	16977.46	16282.51
42	18178.02	17479.51	16784.36	16090.61

Table 10i. Line Positions of DF, P-Branch, Δv = 9 Sequence (Continued)

DF   NU(V,J,-1) , 1/CM , P-BRANCH , DELTA NU = 9

	J= 43	44	45	46	47	48	49
V= 0	17978.05	17774.78	17568.26	17358.51	17145.58	16929.47	16710.23
1	17281.44	17080.04	16875.32	16667.32	16456.06	16241.57	16023.86
2	16587.83	16387.90	16184.60	15977.94	15767.96	15554.66	15338.07
3	15895.23	15696.38	15494.09	15288.37	15079.24	14866.71	14650.78

	J= 50
V= 0	16487.88
1	15802.96
2	15118.19
3	14431.48

Table 10j. Line Positions of DF, P-Branch, $\Delta v = 10$ Sequence

NU(V,J,-1) , 1/CM , P-BRANCH , DELTA NU = 10

J	v=0	v=1	v=2
1	25124.36	24276.68	23440.58
2	25097.14	24250.13	23414.68
3	25064.44	24218.18	23383.44
4	25026.28	24180.84	23346.88
5	24982.68	24138.14	23305.03
6	24933.67	24090.09	23257.89
7	24879.26	24036.73	23205.49
8	24819.48	23978.07	23147.86
9	24754.37	23914.14	23085.03
10	24683.95	23844.97	23017.02
11	24608.25	23770.60	22943.85
12	24527.32	23691.05	22865.57
13	24441.18	23606.37	22782.21
14	24349.88	23516.58	22693.79
15	24253.45	23421.72	22600.36
16	24151.93	23321.84	22501.95
17	24045.38	23216.97	22398.59
18	23933.82	23107.16	22290.33
19	23817.31	22992.44	22177.21
20	23695.89	22872.86	22059.27
21	23569.62	22748.46	21936.54
22	23438.53	22619.30	21809.08
23	23302.68	22485.41	21676.92
24	23162.12	22346.84	21540.11
25	23016.89	22203.64	21398.69
26	22867.06	22055.87	21252.71
27	22712.67	21903.55	21102.21
28	22553.77	21746.76	20947.23
29	22390.42	21585.52	20787.83
30	22222.67	21412.90	20624.03
31	22050.57	21249.93	20455.89
32	21875.17	21075.17	20283.46
33	21693.52	20897.17	20106.77
34	21508.69	20714.47	19925.86
35	21319.71	20527.61	19740.78
36	21126.63	20336.65	19551.57
37	20929.52	20141.62	19358.26
38	20728.41	19942.57	19160.90
39	20523.34	19739.54	18959.52
40	20314.38	19532.57	18754.15
41	20101.55	19321.70	18544.83
42	19884.91	19106.96	18331.59
43	19664.49	18888.40	18114.45
44	19440.32	18666.03	17893.45
45	19212.46	18439.90	17668.61
46	18980.92	18210.03	17439.95
47	18745.75	17976.44	17207.48
48	18506.97	17739.15	16971.23
49	18264.60	17498.20	16731.21
50	18018.66	17253.58	16487.42

Table 10k. Line Positions of DF, P-Branch, Δv = 11 Sequence

DF   NU(V,J,-1) , 1/CM , P-BRANCH , DELTA NU = 11

	1	2	3	4	5	6	7
J=	1	2	3	4	5	6	7
v= 0	27182.93	27155.20	27121.47	27081.76	27036.09	26984.49	26926.99
v= 1	26255.27	26228.20	26195.22	26156.34	26111.58	26060.96	26004.50

	8	9	10	11	12	13	14
J=	8	9	10	11	12	13	14
v= 0	26863.64	26794.36	26718.31	26638.01	26551.87	26459.57	26361.69
v= 1	25942.24	25874.20	25800.42	25720.91	25635.73	25544.90	25448.45

	15	16	17	18	19	20	21
J=	15	16	17	18	19	20	21
v= 0	26258.00	26148.80	26034.07	25913.83	25788.15	25657.06	25520.62
v= 1	25346.44	25238.90	25125.87	25007.39	24883.52	24754.29	24619.74

	22	23	24	25	26	27	28
J=	22	23	24	25	26	27	28
v= 0	25378.88	25231.88	25079.69	24922.35	24759.92	24592.46	24420.01
v= 1	24479.94	24334.92	24184.74	24029.44	23869.07	23703.69	23533.34

	29	30	31	32	33	34	35
J=	29	30	31	32	33	34	35
v= 0	24242.63	24060.37	23873.30	23681.46	23484.91	23283.70	23077.88
v= 1	23358.07	23177.94	22992.99	22803.28	22608.84	22409.74	22206.01

	36	37	38	39	40	41	42
J=	35	37	38	39	40	41	42
v= 0	22867.51	22652.64	22433.39	22209.57	21981.47	21749.05	21512.36
v= 1	21987.71	21782.88	21567.55	21345.78	21119.61	20889.07	20654.19

	43	44	45	46	47	48	49
J=	43	44	45	46	47	48	49
v= 0	21271.52	21026.36	20777.92	20523.63	20266.83	20055.73	19738.93
v= 1	20415.62	20171.36	19923.92	19672.03	19415.83	19155.73	18891.34

	50
J=	50
v= 0	19469.28
v= 1	18622.81

-74-

Table 101. Line Positions of DF, P-Branch, Δv = 12 Sequence

NU(V,J,-1) , 1/CM , P-BRANCH , DELTA NU = 12

DF	1	2	3	4	5	6	7
J=	1	2	3	4	5	6	7
V= 0	29161.52	29133.27	29098.51	29057.25	29009.53	28955.36	28894.76
J=	8	9	10	11	12	13	14
V= 0	28827.78	28754.43	28674.75	28588.78	28496.55	28398.10	28293.48
J=	15	16	17	18	19	20	21
V= 0	28182.71	28065.95	27942.97	27814.07	27679.23	27538.49	27391.90
J=	22	23	24	25	26	27	28
V= 0	27239.52	27081.40	26917.59	26748.14	26573.13	26392.59	26206.59
J=	29	30	31	32	33	34	35
V= 0	26015.18	25818.41	25616.36	25409.06	25196.58	24978.97	24756.29
J=	36	37	38	39	40	41	42
V= 0	24528.58	24295.89	24058.29	23815.81	23568.51	23316.42	23059.59
J=	43	44	45	46	47	48	49
V= 0	22798.07	22531.88	22261.06	21985.64	21705.65	21421.12	21132.07
J=	50						
V= 0	20838.51						

Table 11a. Line Positions of DF, R-Branch, Δv = 1 Sequence

DF

NU(V,J+1) , 1/CM , R-BRANCH , DELTA NU = 1

V=	J= 0	1	2	3	4	5	6
0	2927.98	2945.50	2968.40	2987.66	3006.28	3024.24	3041.53
1	2835.81	2855.77	2878.11	2893.83	2911.92	2929.36	2946.17
2	2745.13	2764.97	2783.76	2801.95	2819.51	2836.44	2852.72
3	2650.03	2675.63	2694.23	2711.89	2728.03	2745.35	2761.14
4	2570.30	2588.79	2606.36	2626.49	2640.03	2655.95	2671.26
5	2485.47	2502.89	2519.99	2536.61	2552.63	2568.06	2582.82
6	2401.04	2418.29	2434.95	2451.06	2466.58	2481.509	2495.82
7	2318.24	2334.43	2351.05	2366.64	2381.69	2396.09	2409.96
8	2236.17	2252.69	2268.08	2283.17	2297.69	2311.62	2324.71
9	2155.01	2170.69	2185.83	2200.41	2214.43	2227.87	2240.71
10	2074.27	2089.42	2104.06	2118.14	2131.65	2144.59	2156.94
11	1993.77	2008.42	2022.54	2036.10	2049.11	2061.54	2073.39

V=	J= 7	8	9	10	11	12	13
0	3058.13	3074.04	3089.24	3103.73	3117.49	3130.51	3142.78
1	2962.35	2977.68	2992.42	3006.45	3019.78	3032.37	3044.24
2	2868.30	2883.07	2897.58	2914.62	2924.07	2936.23	2947.97
3	2776.04	2790.92	2804.58	2817.96	2827.80	2841.92	2852.30
4	2685.05	2699.59	2713.48	2725.96	2727.96	2749.30	2759.93
5	2599.52	2610.59	2624.03	2635.82	2647.30	2658.19	2668.40
6	2512.74	2526.71	2538.71	2546.04	2557.72	2568.40	2578.187
7	2426.20	2435.71	2461.32	2459.72	2469.72	2479.96	2489.107
8	2341.06	2349.20	2372.101	2372.18	2382.96	2391.96	2400.86
9	2257.60	2261.60	2286.09	2286.09	2295.76	2304.86	2313.305
10	2174.60	2174.05	2190.34	2200.56	2209.18	2218.18	2226.15
11	2090.34	2095.30	2105.34	2114.75	2123.53	2131.67	2139.15

V=	J= 14	15	16	17	18	19	20
0	3154.37	3165.06	3175.05	3184.26	3192.68	3200.31	3207.15
1	3055.42	3065.75	3075.37	3084.23	3092.310	3099.62	3106.08
2	2958.06	2968.41	2977.66	2986.16	2993.01	3000.88	3007.27
3	2863.06	2879.07	2881.78	2889.92	2897.35	3003.94	3009.17
4	2770.99	2779.07	2787.63	2795.71	2802.35	2808.64	2814.96
5	2677.24	2686.73	2694.83	2702.21	2708.661	2714.78	2719.60
6	2587.74	2595.72	2603.80	2610.58	2616.450	2622.60	2626.98
7	2409.07	2416.63	2423.48	2519.64	2525.09	2530.05	2535.35
8	2323.48	2416.63	2423.48	2429.64	2345.09	2349.62	2443.14
9	2231.46	2240.09	2246.04	2251.300	2255.86	2259.711	2353.21
10	2231.46	2240.09	2246.04	2251.300	2255.86	2259.711	2262.85
11	2145.97	2152.12	2157.59	2162.37	2166.45	2169.83	2172.49

- 76 -

Table 11a.   Line Positions of DF, R-Branch, Δv = 1 Sequence (Continued)

DF

NU(V,J,+1) , 1/CM , R-BRANCH , DELTA NU = 1

V	J= 21	22	23	24	25	26	27
0	3213.17	3218.39	3222.80	3226.38	3229.15	3231.09	3232.19
1	3111.87	3116.815	3120.94	3124.28	3126.80	3128.50	3129.405
2	3011.51	3017.15	3021.01	3024.07	3026.39	3027.80	3028.204
3	2914.95	2919.206	2922.82	2925.600	2927.59	2928.79	2929.204
4	2818.40	2822.97	2826.20	2828.70	2830.34	2831.31	2831.449
5	2724.06	2728.08	2731.00	2733.16	2734.80	2735.12	2734.963
6	2631.07	2634.388	2636.96	2638.77	2639.80	2640.16	2639.633
7	2538.71	2544.16	2543.87	2545.38	2546.08	2545.96	2545.143
8	2447.108	2453.67	2459.61	2460.26	2456.16	2459.311	2457.369
9	2356.107	2358.96	2366.21	2368.12	2367.58	2366.28	2364.224
10	2261.27	2266.96	2276.91	2275.86	2174.85	2176.07	2176.54
11	2174.44	2175.65	2176.13	2175.86	2174.85	2138.86	2170.54

V	J= 28	29	30	31	32	33	34
0	3232.477	3231.91	3230.52	3228.29	3225.210	3221.30	3216.54
1	3129.478	3129.72	3128.146	3124.74	3121.507	3117.44	3112.04
2	3028.875	3027.340	3025.560	3022.960	3019.517	3015.313	3090.25
3	2929.525	2929.311	2925.608	2922.702	2919.116	2914.730	2810.482
4	2831.321	2831.222	2827.780	2824.046	2820.334	2815.511	2810.607
5	2735.250	2735.112	2729.780	2726.860	2722.745	2717.420	2714.205
6	2638.471	2641.414	2637.496	2534.003	2529.251	2523.709	2517.877
7	2544.119	2546.144	2542.95	2538.613	2534.593	2527.501	2524.248
8	2449.051	2453.19	2448.139	2438.646	2437.721	2427.647	2422.48
9	2357.093	2358.178	2353.178	2348.214	2347.243	2235.647	2227.887
10	2261.623	2267.78	2258.026	2253.260	2246.113	2138.86	2130.77
11	2167.23	2163.14	2158.26	2152.860	2146.113	2138.86	2130.77

V	J= 35	36	37	38	39	40	41
0	3210.94	3204.50	3197.21	3189.08	3180.11	3170.29	3159.62
1	3106.816	3107.651	3090.85	3084.613	3075.541	3065.62	3054.87
2	3090.44	2899.651	2888.114	2981.673	2972.531	2962.497	2951.661
3	2803.73	2896.762	2888.79	2981.75	2870.377	2962.696	2948.673
4	2707.137	2707.722	2788.600	2789.94	2770.780	2759.613	2748.657
5	2610.194	2697.722	2689.60	2680.608	2670.780	2660.94	2648.101
6	2510.314	2602.722	2591.26	2580.098	2571.439	2560.612	2550.090
7	2413.314	2502.008	2491.43	2483.82	2473.055	2463.339	2452.539
8	2416.548	2407.26	2398.84	2385.80	2376.055	2363.46	2351.59
9	2219.48	2210.26	2200.22	2189.43	2177.611	2165.03	2155.59
10	2121.87	2112.13	2101.56	2090.15	2077.89	2064.76	2050.77
11							

Table 11a. Line Positions of DF, R-Branch, Δv = 1 Sequence (Continued)

DF

$NU(V,J,+1)$, 1/CM , R-BRANCH , DELTA NU = 1

V=	J= 42	43	44	45	46	47	48	J= 49
0	3148.10	3135.74	3122.53	3108.48	3093.57	3077.81	3061.19	3043.72
1	3043.27	3030.84	3017.55	3003.42	2988.44	2972.61	2955.92	2938.37
2	2939.89	2927.34	2913.94	2899.70	2884.60	2868.65	2851.85	2834.18
3	2837.76	2825.05	2811.49	2797.09	2781.84	2765.73	2748.76	2728.92
4	2736.65	2723.74	2709.98	2695.38	2679.92	2663.01	2646.41	2626.35
5	2636.56	2623.18	2609.17	2594.31	2578.59	2562.01	2544.56	2524.25
6	2536.06	2523.11	2508.80	2493.64	2477.61	2460.71	2442.92	2422.16
7	2437.06	2423.26	2408.60	2393.08	2376.68	2359.40	2341.23	2322.16
8	2337.55	2323.35	2308.28	2292.34	2275.51	2257.80	2239.14	2216.38
9	2237.73	2223.07	2207.53	2191.11	2173.80	2155.58	2136.44	2112.03
10	2137.29	2122.11	2106.04	2089.08	2071.21	2052.42	2032.70	2012.03
11	2035.89	2020.13	2003.47	1985.90	1967.40	1947.97	1927.59	1906.25

Ta'le 11b. Line Positions of DF, R-Branch, $\Delta v = 2$ Sequence

DF $NU(V,J,+1)$, 1/CM , R-BRANCH , DELTA NU = 2

V	J= 0	1	2	3	4	5	6
0	5742.66	5762.02	5780.?8	5797.12	5812.83	5827.31	5840.54
1	5560.84	5579.65	5597.29	5613.73	5628.97	5642.99	5655.777
2	5382.73	5401.000	5418.112	5434.065	5448.843	5462.440	5474.707
3	5208.050	5226.71	5242.109	5256.877	5262.149	5281.266	5297.297
4	5036.742	5053.71	5069.803	5084.508	5098.459	5111.207	5122.144
5	4867.742	4884.760	4900.639	4914.508	4927.866	4940.302	4951.564
6	4701.157	4717.607	4732.641	4746.911	4759.656	4771.67	4781.78
7	4537.527	4552.827	4567.441	4580.977	4593.370	4604.652	4614.78
8	4374.307	4389.672	4403.76	4416.82	4428.780	4439.52	4449.23
9	4213.07	4227.72	4241.311	4253.82	4265.51	4275.60	4284.83
10	4052.04	4066.48	4079.56	4091.58	4102.51	4112.36	4121.82

V	J= 7	8	9	10	11	12	13
0	5852.51	5863.68	5872.64	5880.79	5887.64	5893.20	5897.45
1	5667.363	5677.587	5686.758	5694.577	5701.118	5706.338	5710.378
2	5485.935	5495.850	5504.824	5512.507	5518.287	5522.526	5526.096
3	5310.105	5317.260	5325.844	5332.097	5338.547	5343.589	5346.017
4	5133.102	5142.805	5151.227	5156.076	5162.96	5166.97	5169.777
5	4961.022	4969.75	4977.337	4983.98	4988.776	4992.407	4995.385
6	4791.882	4799.752	4806.93	4812.93	4817.510	4821.177	4823.85
7	4623.882	4631.172	4638.480	4646.080	4648.510	4653.66	4655.305
8	4454.96	4465.28	4471.60	4476.78	4480.80	4483.66	4485.35
9	4292.96	4299.96	4305.84	4310.57	4314.15	4316.58	4317.87
10	4128.76	4135.29	4140.69	4144.96	4148.09	4150.06	4150.87

V	J= 14	15	16	17	18	19	20
0	5900.30	5902.02	5902.33	5901.32	5898.99	5895.33	5890.34
1	5713.363	5714.502	5715.362	5713.477	5710.952	5707.180	5702.108
2	5529.195	5530.057	5530.997	5529.19	5534.36	5531.260	5517.389
3	5350.057	5350.657	5348.19	5348.057	5344.507	5341.226	5335.28
4	5171.191	5172.73	5172.00	5170.804	5167.501	5160.83	5157.28
5	4997.311	4996.16	4996.807	4994.93	4991.807	4986.96	4980.775
6	4825.111	4825.446	4824.64	4821.647	4818.057	4813.24	4807.201
7	4654.750	4655.18	4653.322	4650.277	4646.008	4641.254	4634.86
8	4485.06	4485.18	4483.59	4480.13	4476.008	4470.54	4463.86
9	4317.04	4316.86	4314.59	4311.13	4306.48	4300.62	4293.56
10	4150.52	4148.99	4146.28	4142.38	4137.29	4130.99	4123.49

Table 11b. Line Positions of DF, R-Branch, Δv = 2 Sequence (Continued)

$NU(V,J,+1)$, 1/CM , R-BRANCH , DELTA NU = 2

DF

V=	J= 21	22	23	24	25	26	27
0	5884.03	5876.39	5867.42	5857.13	5845.07	5832.56	5818.30
1	5695.71	5688.01	5679.02	5668.69	5657.01	5647.15	5629.93
2	5510.88	5503.10	5494.02	5483.66	5472.01	5459.07	5444.72
3	5329.27	5321.40	5312.16	5301.70	5289.65	5276.99	5262.72
4	5150.16	5142.40	5133.09	5122.50	5110.65	5097.55	5083.87
5	4974.16	4965.90	4956.39	4945.72	4933.63	4920.38	4905.87
6	4799.37	4791.43	4781.70	4770.72	4758.85	4724.05	4730.34
7	4627.37	4618.57	4608.51	4597.35	4584.85	4571.12	4556.85
8	4455.28	4446.85	4436.07	4424.95	4412.15	4398.12	4382.90
9	4285.28	4275.79	4265.70	4254.13	4242.95	4225.54	4209.90
10	4114.78	4104.85	4093.70	4081.32	4067.71	4052.86	4036.77

V=	J= 28	29	30	31	32	33	34
0	5802.72	5785.82	5767.61	5748.106	5727.29	5705.18	5681.78
1	5614.43	5597.58	5579.47	5560.12	5539.37	5517.39	5494.13
2	5429.38	5412.54	5394.47	5375.93	5354.49	5332.59	5309.30
3	5247.51	5230.368	5212.28	5192.142	5172.327	5150.56	5127.30
4	5069.19	5050.00	5032.54	5013.42	4992.455	4970.53	4947.26
5	4891.396	4877.20	4854.84	4835.42	4814.552	4792.53	4769.26
6	4719.39	4697.21	4678.76	4659.89	4638.12	4615.92	4592.57
7	4539.34	4522.52	4503.88	4483.33	4462.82	4440.06	4416.57
8	4366.31	4346.58	4329.58	4309.33	4287.82	4265.06	4241.04
9	4193.01	4174.84	4155.48	4134.89	4112.94	4089.78	4065.35
10	4019.43	4000.84	3981.00	3959.89	3937.51	3913.87	3888.95

V=	J= 35	36	37	38	39	40	41
0	5657.09	5631.12	5603.87	5575.35	5545.57	5514.52	5482.22
1	5469.60	5443.79	5416.72	5388.12	5358.12	5327.95	5295.65
2	5284.90	5259.27	5232.33	5204.175	5174.75	5143.92	5111.07
3	5102.906	5077.227	5050.333	5022.175	4992.175	4962.06	4930.167
4	4922.73	4897.295	4870.91	4842.09	4812.708	4782.011	4750.022
5	4744.78	4718.95	4691.611	4663.14	4634.708	4603.28	4571.022
6	4567.78	4541.82	4514.611	4486.200	4456.41	4425.42	4393.16
7	4391.06	4365.82	4337.94	4309.200	4279.20	4247.28	4215.37
8	4215.76	4189.21	4161.40	4132.30	4101.93	4070.28	4037.33
9	4039.66	4012.68	3984.43	3954.89	3924.05	3891.92	3858.48
10	3862.74	3835.25	3806.46	3776.37	3744.98	3712.26	3678.22

Table 11b. Line Positions of DF, R-Branch, $\Delta v = 2$ Sequence (Continued)

DF   NU(V,J,+1) , 1/CM , R-BRANCH , DELTA NU = 2

V=	J= 42	43	44	45	46	47	48
0	5448.67	5413.88	5377.84	5340.56	5302.05	5262.30	5221.32
1	5262.50	5227.91	5192.07	5155.00	5116.69	5077.13	5036.34
2	5078.74	5044.27	5008.56	4971.61	4933.41	4893.97	4853.29
3	4897.00	4862.58	4826.92	4790.00	4751.83	4712.41	4671.73
4	4716.90	4682.41	4646.70	4609.74	4571.56	4532.28	4491.24
5	4537.63	4503.32	4467.48	4430.36	4391.97	4352.77	4311.53
6	4359.63	4324.83	4288.75	4251.38	4212.73	4172.77	4131.51
7	4181.59	4146.41	4110.00	4072.28	4033.26	3992.91	3951.96
8	4003.73	3967.55	3930.69	3892.51	3853.00	3812.16	3769.96
9	3823.73	3787.65	3750.24	3711.49	3671.38	3629.91	3587.06
10	3642.85	3606.13	3568.05	3528.61	3487.78	3445.56	3401.93

V=	J= 49
0	5179.11
1	4994.31
2	4811.35
3	4629.79
4	4449.19
5	4269.08
6	4088.94
7	3908.23
8	3726.39
9	3542.81
10	3356.87

Table 11c. Line Positions of DF, R-Branch, $\Delta v = 3$ Sequence

DF $\mathrm{NU(V,J,J+1)}$, 1/CM , R-BRANCH , DELTA NU = 3

v	J=0	J=1	J=2	J=3	J=4	J=5	J=6
0	8467.69	8485.91	8502.35	8517.01	8529.88	8540.94	8550.19
1	8198.05	8215.69	8231.64	8245.82	8258.23	8266.95	8277.84
2	7933.21	7950.82	7966.28	7980.02	7992.04	8002.31	8010.84
3	7674.01	7690.87	7705.84	7718.13	7730.71	7740.58	7748.73
4	7419.41	7435.76	7449.84	7462.67	7473.82	7483.89	7491.05
5	7168.13	7183.76	7197.77	7210.13	7220.84	7229.83	7237.26
6	6920.40	6935.06	6949.09	6960.95	6971.32	6979.50	6986.79
7	6675.58	6690.06	6703.09	6714.18	6724.52	6732.50	6739.04
8	6432.58	6446.70	6459.24	6472.C.18	6479.52	6487.25	6493.35
9	6191.14	6204.76	6216.80	6227.26	6236.12	6243.37	6249.01

v	J=7	J=8	J=9	J=10	J=11	J=12	J=13
0	8557.62	8563.21	8566.98	8568.90	8568.98	8567.20	8563.58
1	8284.60	8290.25	8293.76	8295.45	8295.38	8294.47	8289.67
2	8017.06	8022.61	8025.84	8027.30	8026.98	8024.98	8020.97
3	7755.16	7751.85	7762.79	7763.02	7763.43	7761.12	7757.04
4	7497.50	7501.47	7504.27	7505.02	7503.21	7501.66	7497.38
5	7246.04	7246.96	7248.09	7249.97	7248.78	7245.44	7241.44
6	6992.10	6995.73	6997.69	6997.67	6996.55	6993.47	6988.63
7	6743.87	6747.18	6748.76	6748.67	6746.55	6743.47	6738.39
8	6497.81	6500.64	6501.81	6501.33	6499.19	6495.38	6489.89
9	6253.03	6255.41	6256.15	6255.24	6252.68	6248.46	6242.57

v	J=14	J=15	J=16	J=17	J=18	J=19	J=20
0	8558.10	8550.77	8541.58	8530.54	8517.64	8502.90	8486.30
1	8284.10	8276.70	8267.49	8256.58	8243.58	8228.94	8212.40
2	8015.28	8007.80	7998.52	7987.44	7974.57	7959.45	7943.49
3	7749.36	7744.59	7734.06	7723.06	7710.14	7695.45	7677.78
4	7491.35	7483.58	7474.51	7462.09	7449.77	7435.01	7418.49
5	7235.18	7227.90	7217.51	7206.08	7192.96	7178.02	7161.39
6	6980.12	6973.04	6962.70	6952.32	6938.28	6923.88	6907.92
7	6731.03	6723.87	6712.80	6700.89	6687.28	6671.95	6654.92
8	6482.87	6473.64	6463.33	6451.10	6437.17	6421.54	6404.21
9	6235.00	6225.76	6214.75	6202.22	6187.91	6171.90	6154.20

v	J=21	J=22	J=23	J=24	J=25	J=26	J=27
0	8467.87	8447.59	8425.48	8401.54	8375.78	8348.21	8318.83
1	8194.08	8173.95	8152.02	8128.28	8102.75	8075.43	8046.32
2	7925.18	7905.18	7883.02	7859.77	7834.40	7807.26	7778.36
3	7660.78	7640.78	7619.02	7595.58	7570.24	7543.27	7514.40
4	7400.22	7380.22	7358.13	7334.98	7309.74	7282.77	7254.07
5	7143.04	7122.95	7101.13	7077.10	7052.31	7025.31	6996.38
6	6880.57	6868.73	6846.38	6822.71	6797.31	6770.20	6741.05
7	6635.73	6615.42	6596.97	6569.97	6544.44	6516.20	6487.05
8	6385.17	6364.42	6341.92	6317.81	6291.94	6264.35	6235.05
9	6134.79	6113.68	6090.86	6066.33	6040.08	6012.12	5982.45

- 82 -

Table 11c.   Line Positions of DF, R-Branch, $\Delta v = 3$ Sequence (Continued)

NU(V,J,+1) , 1/CM , R-BRANCH , DELTA NU = 3

V	J= 28	29	30	31	32	33	34
0	8287.65	8254.69	8219.94	8183.43	8145.15	8105.13	8063.30
1	8015.47	7982.79	7948.38	7912.21	7874.31	7834.67	7793.25
2	7747.74	7715.30	7681.74	7645.26	7607.64	7568.30	7527.26
3	7483.63	7451.71	7417.60	7382.04	7344.67	7305.50	7264.97
4	7223.63	7191.48	7157.60	7122.00	7084.70	7045.68	7004.54
5	6976.14	6933.98	6900.11	6864.52	6827.23	6788.23	6741.75
6	6710.05	6678.59	6644.63	6608.95	6571.57	6532.49	6491.75
7	6457.05	6424.61	6390.46	6354.60	6317.57	6277.74	6236.92
8	5951.05	6117.32	6136.87	6100.71	6062.83	6023.24	5981.92
9		5917.93	5883.09	5846.52	5808.22	5768.19	5726.42

V	J= 35	36	37	38	39	40	41
0	8019.87	7974.66	7927.74	7879.12	7828.82	7776.84	7723.20
1	7750.22	7705.43	7658.88	7610.47	7560.91	7545.38	7456.48
2	7484.13	7440.03	7393.98	7346.04	7296.52	7245.34	7192.48
3	7222.56	7177.90	7131.65	7084.17	7035.00	6984.13	6931.51
4	6962.14	6918.05	6872.26	6825.78	6776.00	6725.71	6672.63
5	6705.72	6661.00	6615.20	6567.55	6518.22	6467.22	6415.02
6	6449.08	6405.62	6359.20	6311.65	6262.09	6211.22	6160.51
7	6194.48	6149.62	6103.49	6055.39	6006.43	5954.61	5901.81
8	5938.88	5894.88	5847.62	5799.30	5749.43	5697.73	5644.28
9	5682.91	5637.67	5590.67	5541.93	5491.42	5439.15	5385.11

V	J= 42	43	44	45	46	47	48
0	7667.90	7610.95	7552.36	7492.14	7430.50	7366.82	7301.74
1	7401.97	7344.84	7286.70	7226.91	7165.11	7102.45	7037.78
2	7137.21	7081.26	7023.04	6964.52	6903.42	6840.66	6776.26
3	6876.44	6820.56	6765.01	6704.78	6643.42	6580.82	6516.50
4	6616.97	6560.04	6503.61	6445.78	6384.88	6322.36	6258.02
5	6364.10	6305.04	6247.42	6188.09	6127.09	6064.29	6000.22
6	6047.98	6047.98	5990.14	5930.50	5869.05	5806.28	5741.50
7	5847.08	5790.61	5732.41	5672.46	5610.75	5547.28	5482.07
8	5589.28	5532.12	5473.40	5412.89	5350.59	5286.49	5220.57
9	5329.28	5271.67	5212.26	5151.02	5087.96	5023.05	4956.29

V	J= 49
0	7235.05
1	6971.48
2	6645.00
3	6192.05
4	5635.03
5	5674.93
6	5452.82
7	4887.65

Table 11d. Line Positions of DF, R-Branch, $\Delta v = 4$ Sequence

DF   NU(V,J,+1) , 1/CM , R-BRANCH , DELTA NU = 4

V	J=0	J=1	J=2	J=3	J=4	J=5	J=6
0	11104.85	11121.94	11136.71	11149.13	11159.20	11166.90	11172.24
1	10748.92	10765.51	10779.80	10791.900	10801.649	10808.86	10813.90
2	10369.81	10411.70	10429.73	10441.300	10450.661	10457.63	10462.37
3	10056.90	10072.51	10085.88	10097.029	10105.093	10112.40	10117.01
4	9719.60	9734.68	9747.59	9758.229	9766.809	9773.09	9777.17
5	9387.18	9402.70	9414.13	9424.440	9432.449	9438.72	9442.16
6	9058.18	9072.78	9084.74	9094.550	9102.225	9107.72	9111.06
7	8733.49	8747.09	8758.57	8767.920	8775.15	8780.23	8783.16
8	8410.65	8423.74	8434.73	8443.620	8450.38	8455.02	8457.52

V	J=7	J=8	J=9	J=10	J=11	J=12	J=13
0	11175.20	11175.78	11173.98	11169.70	11163.04	11154.23	11142.87
1	10816.62	10816.99	10815.02	10810.70	10804.054	10795.02	10783.66
2	10464.81	10464.95	10462.79	10457.809	10451.107	10442.489	10431.05
3	10119.02	10119.06	10116.68	10112.01	10105.027	10095.860	10084.41
4	9779.02	9778.63	9776.003	9771.914	9764.557	9754.661	9743.05
5	9443.24	9442.949	9440.97	9434.916	9427.507	9418.014	9406.122
6	9112.29	9111.19	9107.97	9102.56	9094.930	9085.149	9073.122
7	8783.88	8782.54	8778.97	8773.23	8765.30	8755.19	8742.89
8	8457.88	8456.08	8452.13	8446.01	8437.72	8427.26	8414.61

V	J=14	J=15	J=16	J=17	J=18	J=19	J=20
0	11123.42	11112.97	11094.45	11073.54	11050.64	11026.22	10996.69
1	10765.04	10753.88	10735.47	10714.72	10691.36	10666.22	10638.47
2	10417.33	10401.300	10382.96	10362.31	10339.36	10314.11	10286.56
3	10070.64	10054.59	10036.26	10015.66	9991.19	9965.809	9940.21
4	9722.209	9713.95	9695.47	9674.06	9651.03	9626.607	9598.278
5	9392.209	9372.45	9360.95	9336.75	9313.87	9288.067	9261.28
6	9058.809	9042.45	9023.82	9002.73	8979.87	8954.59	8927.107
7	8728.09	8711.70	8692.82	8671.73	8648.44	8622.95	8595.27
8	8399.77	8382.77	8363.57	8342.18	8318.60	8292.82	8264.85

V	J=21	J=22	J=23	J=24	J=25	J=26	J=27
0	10966.24	10933.54	10898.50	10861.13	10821.46	10779.48	10735.22
1	10608.44	10576.04	10541.36	10504.39	10465.14	10423.62	10379.84
2	10256.73	10224.61	10190.22	10153.57	10114.66	10073.50	10030.11
3	9910.53	9878.27	9844.42	9807.92	9769.33	9728.45	9685.36
4	9568.68	9537.42	9503.89	9466.57	9428.112	9387.70	9344.78
5	9231.68	9199.85	9165.89	9129.57	9091.57	9050.46	9007.62
6	8897.40	8865.49	8831.02	8795.08	8756.58	8715.88	8673.08
7	8565.30	8533.30	8499.55	8462.55	8423.58	8383.03	8339.98
8	8234.68	8202.32	8167.76	8131.01	8092.07	8050.93	8007.60

Table 11d. Line Positions of DF, R-Branch, $\Delta v = 4$ Sequence (Continued)

DF   NU(V,J,+1) , 1/CM , R-BRANCH , DELTA NU = 4

V	J= 28	J= 29	J= 30	J= 31	J= 32	J= 33	J= 34
0	10688.69	10639.89	10588.85	10535.58	10480.09	10422.41	10362.54
1	10333.81	10285.54	10235.06	10182.36	10127.46	10070.38	10011.43
2	09940.02	09936.65	09886.61	09834.37	09779.95	09723.36	09664.61
3	09552.35	09592.35	09542.87	09490.91	09436.87	09380.09	09322.25
4	09125.37	08915.37	08865.98	08811.41	08760.37	08704.80	08646.76
5	08627.93	08580.68	08531.25	08479.66	08425.89	08369.96	08311.87
6	08204.76	08204.37	08196.75	08145.98	08092.04	08035.92	07977.98
7	07962.08	07914.37	07864.47	07812.39	07758.11	07701.64	07642.98

V	J= 35	J= 36	J= 37	J= 38	J= 39	J= 40	J= 41
0	10300.49	10236.30	10169.96	10101.51	10030.94	09958.28	09883.55
1	09603.77	09886.17	09825.49	09752.69	09682.79	09610.80	09536.72
2	09202.92	09540.07	09475.52	09408.24	09338.86	09267.28	09193.83
3	08586.53	09199.07	09134.29	09067.39	08998.39	08927.28	08854.07
4	08251.77	08860.55	08796.07	08729.33	08664.41	08253.56	08516.57
5	07582.10	08524.22	08459.67	08557.97	08293.16	07918.11	08180.57
6		08184.50	08124.67	08222.67	07789.15	07582.26	07844.95
7		07519.10	07453.87	07386.43	07316.18	07244.96	07508.76
8							07170.91

V	J= 42	J= 43	J= 44	J= 45	J= 46	J= 47	J= 48
0	09806.74	09727.88	09646.98	09564.05	09479.4	09392.4	09303.18
1	09460.58	09382.37	09302.12	09219.83	09141.09	09049.07	08960.75
2	09118.78	09040.48	08960.74	08878.88	08807.56	08709.10	08621.08
3	08778.78	08701.40	08621.94	08540.41	08474.41	08371.10	08284.03
4	08441.50	08364.28	08284.82	08293.00	08144.66	08034.36	07946.60
5	08105.00	08028.20	07948.85	07867.00	07783.66	07697.88	07609.93
6	07769.07	07692.18	07612.55	07530.70	07441.04	07360.65	07272.34
7	07443.07	07355.19	07275.12	07192.83	07108.34	07021.61	06932.64
8	07094.64	07016.14	06935.40	06852.42	06767.16	06679.63	06589.80

V	J= 49
0	09212.21
1	08870.35
2	08531.48
3	08193.43
4	07856.85
5	07518.41
6	07184.41
7	06844.41
8	06497.66

Table 11e. Line Positions of DF, R-Branch, Δv = 5 Sequence

NU(V,J,+1) , 1/CM , R-BRANCH , DELTA NU = 5

J = 0

v	0	1	2	3	4	5	6
0	13655.77	13671.76	13684.87	13695.09	13702.06	13706.81	13708.30
1	13215.08	13230.58	13243.77	13253.08	13260.83	13264.18	13265.43
2	12782.53	12797.54	12809.77	12819.20	12825.83	12829.64	12830.64
3	12357.31	12371.84	12383.62	12392.65	12398.45	12402.41	12403.13
4	11938.59	11952.62	11963.95	11972.56	11978.45	11982.29	11982.02
5	11425.74	11438.94	11549.81	11558.00	11563.50	11566.29	11566.37
6	10711.56	10724.13	10734.06	10741.36	10753.04	10748.01	10747.34

J = 7

v	7	8	9	10	11	12	13
0	13706.87	13702.52	13695.24	13685.04	13671.90	13655.84	13636.86
1	13258.82	13251.36	13251.97	13241.72	13228.60	13212.61	13191.74
2	12828.07	12824.22	12816.68	12806.46	12793.21	12777.23	12758.41
3	12401.80	12404.61	12388.58	12378.14	12364.91	12348.70	12330.08
4	11979.74	11974.74	11966.77	11956.31	11925.97	11509.71	11490.70
5	11563.74	11558.39	11550.31	11538.18	11113.34	11096.86	11077.67
6	10737.98	10737.98	10729.29	10717.90	10703.83	10687.07	10667.61

J = 14

v	14	15	16	17	18	19	20
0	13614.96	13590.15	13562.43	13531.82	13498.32	13461.93	13422.68
1	13171.99	13147.38	13169.91	13089.59	13056.42	13020.41	12981.58
2	12736.77	12712.30	12685.01	12654.93	12621.99	12585.28	12547.78
3	12308.49	12284.07	12256.89	12226.75	12194.20	12145.56	12120.60
4	11886.97	11861.50	11834.65	11804.79	11354.74	11736.37	11281.29
5	11468.97	11444.50	11417.31	11387.39	11319.37	11095.59	10867.44
6	10645.46	10620.60	10593.06	10562.91	10529.87	10494.24	10455.91

J = 21

v	21	22	23	24	25	26	27
0	13380.57	13335.62	13287.84	13237.24	13183.85	13127.68	13068.74
1	12936.92	12895.47	12848.22	12798.19	12745.40	12689.86	12631.59
2	12462.49	12462.43	12415.60	12366.05	12313.75	12258.62	12200.05
3	12079.41	12035.65	11989.16	11939.94	11888.01	11833.37	11776.05
4	11657.75	11614.01	11567.89	11518.91	11467.23	11412.86	11355.82
5	10826.60	10783.07	10736.85	10687.94	10636.36	10582.11	10525.24
6	10414.90	10371.20	10324.81	10275.75	10224.02	10169.61	10112.53

J = 28

v	28	29	30	31	32	33	34
0	13007.06	12942.65	12875.53	12805.72	12733.25	12658.12	12580.36
1	12570.09	12506.90	12440.52	12371.47	12299.77	12225.44	12148.49
2	12140.56	12077.45	11588.67	11943.24	11872.17	11798.49	11722.20
3	11716.05	11653.39	11588.07	11520.11	11449.53	11376.33	11300.53
4	10879.67	10817.46	10752.60	10685.12	10615.00	10542.27	10466.93
5	10465.63	10403.41	10338.55	10271.04	10200.90	10128.16	10052.75
6	10052.80	9990.40	9925.35	9857.65	9787.31	9714.32	9638.69

Table 11e. Line Positions of DF, R Branch, $\Delta v = 5$ Sequence (Continued)

DF $NU(V,J,+1)$, 1/CM , R-BRANCH , DELTA NU = 5

V=	J= 35	36	37	38	39	40	41
0	12499.99	12417.04	12331.51	12243.43	12152.82	12059.70	11964.08
1	12068.95	11986.82	11902.13	11814.90	11725.13	11632.85	11538.06
2	11643.31	11561.85	11477.83	11391.26	11302.16	11210.53	11116.39
3	11222.64	11141.17	11057.64	10971.51	10882.92	10791.75	10698.06
4	10808.40	10723.74	10640.51	10554.71	10466.35	10375.44	10281.98
5	10388.99	10308.45	10225.32	10139.06	10051.31	9960.45	9867.00
6	9974.74	9894.74	9810.89	9725.06	9636.61	9545.56	9451.00
7	9560.42	9479.51	9395.96	9309.78	9220.96	9129.50	9035.39

V=	J= 42	43	44	45	46	47	48
0	11865.98	11765.42	11662.41	11556.96	11449.10	11338.82	11226.15
1	11440.79	11341.05	11238.84	11134.18	11027.08	10917.54	10805.57
2	11019.76	10920.63	10819.02	10714.93	10608.37	10499.35	10387.86
3	10601.85	10503.12	10401.89	10298.15	10191.91	10083.17	9971.92
4	10185.98	10087.44	9986.35	9882.74	9776.58	9667.17	9556.62
5	9770.99	9672.40	9571.23	9467.49	9361.16	9252.24	9140.71
6	9355.63	9256.76	9155.26	9051.14	8944.31	8834.48	8722.92
7	8938.63	8639.21	8737.12	8632.36	8524.91	8414.75	8301.87

V=	J= 49
0	11111.08
1	10691.18
2	10273.07
3	9858.17
4	9442.80
5	9026.58
6	8608.19
7	8186.25

Table 11f. Line Positions of DF, R-Branch, Δv = 6 Sequence

NU(V,J,+1) , 1/CM , R-BRANCH , DELTA NU = 6

DF

v	J=0	1	2	3	4	5	6
0	16121.90	16136.84	16148.32	16156.37	16160.97	16162.13	16159.83
1	15597.80	15612.23	15623.29	15630.98	15635.28	15636.19	15633.71
2	15082.92	15096.87	15107.51	15114.83	15118.56	15119.02	15116.76
3	14576.36	14589.77	14599.98	14606.92	14610.56	14610.92	14607.98
4	14076.86	14089.86	14099.63	14106.17	14109.42	14109.50	14106.28
5	13583.45	13595.96	13605.29	13611.41	13614.32	13614.02	13610.49
6	13094.81	13106.84	13115.71	13121.40	13123.94	13123.29	13119.35

v	J=7	8	9	10	11	12	13
0	16154.08	16144.86	16132.19	16116.06	16096.47	16073.43	16046.94
1	15627.83	15618.54	15605.86	15589.27	15570.27	15547.38	15521.10
2	15110.72	15101.32	15088.58	15072.48	15053.03	15030.23	15004.08
3	14601.74	14592.06	14579.34	14563.18	14543.71	14520.40	14494.86
4	14099.74	14090.06	14077.05	14060.77	14041.22	14018.40	13992.31
5	13603.74	13593.75	13580.53	13564.07	13544.37	13521.43	13495.25
6	13112.28	13101.99	13088.50	13071.79	13051.87	13028.74	13002.39

v	J=14	15	16	17	18	19	20
0	16017.01	15983.66	15946.88	15906.69	15863.16	15816.12	15765.78
1	15490.43	15458.39	15420.97	15386.18	15342.61	15297.54	15247.99
2	14974.60	14941.78	14905.64	14866.07	14823.01	14777.34	14729.31
3	14465.68	14432.85	14396.86	14357.62	14315.12	14267.43	14220.61
4	13962.96	13930.35	13897.49	13858.22	13813.90	13767.38	13721.64
5	13465.84	13433.19	13397.42	13358.37	13315.92	13270.38	13221.64
6	12972.82	12940.04	12904.06	12864.86	12822.47	12776.87	12728.09

v	J=21	22	23	24	25	26	27
0	15712.08	15655.29	15594.70	15530.84	15464.49	15393.08	15302.46
1	15188.06	15133.34	15073.61	15010.87	14944.02	14875.49	14727.99
2	14668.55	14612.55	14560.36	14498.02	14432.82	14363.65	14264.50
3	14159.44	14103.44	14052.90	13991.28	13926.49	13858.53	13758.84
4	13662.71	13611.58	13552.90	13491.28	13426.49	13358.53	13258.84
5	13169.71	13114.58	13056.28	12994.80	12930.16	12862.37	12762.49
6	12676.11	12620.96	12562.64	12501.14	12436.50	12368.69	12297.75

v	J=28	29	30	31	32	33	34
0	15243.84	15164.00	15080.99	14994.00	14905.56	14813.18	14717.72
1	14726.66	14647.69	14565.58	14480.32	14391.99	14300.57	14206.08
2	14216.50	14138.32	14059.94	13972.40	13884.08	13794.89	13700.48
3	13713.17	13634.78	13559.94	13470.00	13382.98	13292.89	13209.75
4	13217.19	13135.83	13055.94	12971.80	12885.15	12795.42	12707.64
5	12676.19	12640.19	12559.36	12476.19	12390.15	12300.45	12207.81
6	12223.67	12146.47	12066.15	11982.71	11896.18	11806.54	11713.81

-88-

Table 11f. Line Positions of DF, R-Branch, $\Delta v = 6$ Sequence (Continued)

DF

NU(V,J,+1) , 1/CM , R-BRANCH , DELTA NU = 6

V=	J= 35	36	37	38	39	40	41
0	14619.22	14517.69	14413.15	14305.63	14195.16	14081.75	13965.42
1	14108.55	14008.00	13904.45	13797.92	13688.43	13575.99	13460.63
2	13603.72	13503.95	13401.18	13295.42	13186.69	13075.01	12960.38
3	13103.57	13004.95	12902.15	12796.93	12688.73	12577.56	12463.41
4	12608.81	12507.95	12406.06	12301.15	12193.24	12082.30	11968.41
5	12112.01	12013.35	11911.54	11806.70	11698.82	11587.90	11473.95
6	11618.00	11519.11	11417.14	11312.10	11203.98	11092.79	10978.53

V=	J= 42	43	44	45	46	47	48
0	13846.19	13724.09	13599.13	13471.32	13340.69	13207.23	13070.97
1	13342.36	13221.20	13097.15	12970.23	12840.46	12707.83	12572.35
2	12842.82	12722.35	12598.96	12472.67	12343.49	12211.68	12076.93
3	12346.52	12226.28	12103.29	11977.36	11848.49	11716.68	11587.40
4	11851.98	11731.63	11608.76	11482.91	11354.07	11222.23	10?91.33
5	11356.98	11236.97	11113.94	10987.86	10858.76	10726.57	10?87.40
6	10861.19	10740.78	10617.27	10490.67	10360.96	10228.12	10092.15

V=	J= 49
0	12931.91
1	12434.01
2	11938.24
3	11444.55
4	10949.55
5	10453.03
6	9953.03

Table 11g. Line Positions of DF, R-Branch, $\Delta v = 7$ Sequence

DF   NU(V,J,+1) , 1/CM , R-BRANCH , DELTA NU = 7

J	v=0	v=1	v=2	v=3	v=4	v=5
0	18504.64	17898.18	17301.90	16715.80	16134.92	15561.52
1	18518.48	17911.55	17314.80	16727.01	16146.88	15573.00
2	18528.36	17921.80	17323.87	16735.66	16155.10	15580.78
3	18534.26	17926.60	17329.09	16740.52	16159.57	15584.85
4	18536.20	17928.27	17330.46	16741.57	16160.28	15585.19
5	18534.15	17927.01	17327.97	16738.82	16157.23	15581.80
6	18528.11	17919.83	17321.62	16732.24	16150.40	15574.67
7	18518.09	17910.73	17311.39	16721.80	16139.80	15563.81
8	18504.08	17897.00	17297.30	16707.65	16125.42	15549.20
9	18486.08	17877.75	17279.34	16689.62	16107.26	15530.84
10	18464.10	17855.88	17257.51	16667.77	16085.33	15508.74
11	18438.09	17830.69	17231.82	16642.11	16059.61	15482.85
12	18408.21	17800.38	17202.27	16612.63	16030.12	15453.30
13	18374.31	17766.77	17168.87	16579.34	15996.86	15419.97
14	18336.45	17729.26	17131.61	16542.85	15959.65	15382.90
15	18294.67	17687.87	17090.52	16501.37	15919.04	15342.09
16	18248.93	17642.60	17045.60	16476.50	15874.50	15297.56
17	18199.28	17593.66	16996.87	16408.24	15826.21	15247.30
18	18145.73	17540.47	16944.33	16356.18	15774.18	15197.33
19	18088.65	17483.99	16887.99	16300.04	15718.43	15141.66
20	18027.00	17423.88	16827.88	16240.35	15658.95	15082.28
21	17961.85	17356.39	16764.01	16176.78	15575.78	15019.22
22	17892.87	17290.34	16696.79	16104.91	15528.91	14952.48
23	17820.09	17218.35	16625.04	16038.85	15450.36	14882.07
24	17743.52	17142.52	16549.98	15964.14	15386.14	14808.01
25	17663.20	17063.16	16471.23	15886.08	15306.27	14730.30
26	17579.14	16980.01	16388.81	15804.77	15224.77	14648.95
27	17491.37	16893.74	16302.74	15718.71	15139.64	14563.99
28	17399.91	16802.69	16213.60	15629.90	15050.90	14475.42
29	17304.80	16708.57	16119.71	15536.87	14958.57	14363.25
30	17206.05	16610.84	16022.81	15440.71	14862.96	14287.50
31	17103.70	16509.54	15922.33	15340.71	14763.17	14188.17
32	16997.78	16404.67	15818.30	15237.30	14660.16	14085.29
33	16888.30	16296.27	15710.76	15130.37	14553.65	13978.85
34	16775.31	16184.36	15599.70	15019.92	14443.52	13863.87
35	16658.82	16068.96	15485.99	14905.99	14329.93	13755.36
36	16538.86	15950.10	15367.57	14788.57	14212.85	13638.33
37	16415.47	15827.80	15244.70	14667.70	14092.28	13517.79
38	16288.66	15702.08	15120.80	14543.38	13968.24	13393.74
39	16158.46	15572.96	14992.50	14414.50	13840.74	13266.18
40	16024.89	15440.47	14860.81	14284.44	13709.78	13135.13
41	15887.99	15304.52	14725.74	14149.85	13575.37	13000.58

Table 11g. Line Positions of DF, R-Branch, $\Delta v = 7$ Sequence (Continued)

NU(V,J,+1) , 1/CM , R-BRANCH , DELTA NU = 7

DF

V=	J= 42	43	44	45	46	47	48
0	15747.76	15604.24	15457.44	15307.37	15154.06	14997.52	14837.75
1	15165.43	15022.92	14877.09	14727.98	14575.57	14419.89	14260.94
2	14587.30	14445.50	14300.36	14151.88	14000.07	13844.93	13686.46
3	14011.86	13870.47	13725.70	13577.53	13425.98	13271.05	13112.72
4	13437.51	13296.21	13151.47	13003.29	12851.65	12696.57	12538.01
5	12862.54	12720.99	12575.95	12427.39	12275.32	12119.71	11960.56

V=	J= 49
0	14674.77
1	14098.72
2	13524.66
3	12950.99
4	12375.99
5	11797.85

Table 11h. Line Positions of DF, R-Branch, Δv = 8 Sequence

DF $NU(V,J,J+1)$, 1/CM , R-BRANCH , DELTA NU = 8

v	J=0	J=1	J=2	J=3	J=4	J=5	J=6
0	20805.03	20817.81	20826.10	20829.89	20829.18	20823.96	20814.23
1	20117.16	20129.49	20137.39	20140.87	20139.92	20134.52	20124.68
2	19440.84	19452.04	19459.55	19462.70	19461.47	19455.86	19445.88
3	18772.54	18784.04	18793.14	18793.93	18792.40	18786.55	18776.36
4	18112.99	18123.92	18130.60	18133.01	18131.15	18125.01	18114.58

v	J=7	J=8	J=9	J=10	J=11	J=12	J=13
0	20799.99	20781.24	20757.97	20730.21	20697.88	20661.20	20619.98
1	20110.40	20091.68	20068.52	20040.92	20008.88	19972.43	19931.55
2	19431.51	19412.76	19389.62	19362.11	19330.22	19293.97	19253.35
3	18762.76	18743.87	18719.83	18692.30	18660.50	18624.35	18583.89
4	18099.87	18080.87	18057.58	18030.00	17998.14	17962.00	17921.58

v	J=14	J=15	J=16	J=17	J=18	J=19	J=20
0	20574.28	20524.61	20463.56	20410.56	20347.15	20279.36	20207.21
1	19886.28	19836.08	19782.50	19724.15	19661.39	19594.30	19522.90
2	19208.12	19159.06	19105.44	19047.49	18985.24	18918.05	18847.89
3	18539.12	18490.06	18436.70	18379.08	18317.19	18251.05	18180.67
4	17876.89	17827.94	17774.74	17717.29	17655.61	17589.71	17519.60

v	J=21	J=22	J=23	J=24	J=25	J=26	J=27
0	20130.73	20049.92	19964.83	19875.47	19781.87	19684.07	19582.08
1	19442.21	19367.24	19282.05	19194.60	19101.97	19005.17	18904.24
2	18772.83	18693.55	18610.05	18524.16	18430.49	18335.05	18234.35
3	18106.08	18027.28	17944.31	17857.16	17765.87	17670.44	17570.91
4	17445.29	17366.80	17284.15	17197.35	17106.41	17011.35	16912.19

v	J=28	J=29	J=30	J=31	J=32	J=33	J=34
0	19475.94	19365.68	19251.32	19132.90	19010.46	18884.01	18753.59
1	18799.13	18689.96	18576.72	18459.43	18338.12	18212.83	18083.58
2	18130.12	18021.80	17909.43	17793.09	17672.62	17548.54	17419.80
3	17467.24	17359.60	17249.86	17134.65	17015.43	16888.24	16760.80
4	16808.94	16701.63	16590.26	16474.85	16355.43	16232.00	16104.58

v	J=35	J=36	J=37	J=38	J=39	J=40	J=41
0	18619.23	18480.96	18338.81	18192.81	18042.99	17889.37	17731.97
1	17950.39	17813.29	17672.30	17527.46	17378.77	17226.27	17069.98
2	17287.57	17151.36	17011.24	16867.25	16719.39	16567.70	16412.17
3	16629.11	16493.47	16353.92	16210.47	16063.12	15911.90	15756.81
4	15973.19	15837.84	15698.53	15555.28	15408.11	15257.01	15102.00

Table 11h.　Line Positions of DF, R-Branch, $\Delta v = 8$ Sequence (Continued)

DF

$$NU(V,J,+1) \;,\; 1/CM \;,\; \text{R-BRANCH} \;,\; \text{DELTA NU} = 8$$

$J=$	42	43	44	45	46	47	48
$V=$ 0	17670.83	17405.96	17237.38	17065.12	16889.18	16709.58	16526.34
1	16609.90	16746.07	16578.49	16407.18	16232.15	16053.41	15870.95
2	16252.86	16089.70	15922.77	15752.06	15577.56	15399.29	15217.24
3	15507.86	15435.05	15268.41	15097.91	14923.57	14745.38	14563.33
4	14943.07	14780.23	14613.46	14442.81	14268.23	14089.71	13907.25

$J=$	49
$V=$ 0	16339.45
1	15684.79
2	15031.41
3	14377.42
4	13720.82

-93-

Table 11. Line Positions of DF, R-Branch, $\Delta v = 9$ Sequence

DF   NU(V,J,+1) , 1/CM , R-BRANCH , DELTA NU = 9

v=	J= 0	J= 1	J= 2	J= 3	J= 4	J= 5	J= 6
0	23024.01	23035.74	23042.46	23044.16	23040.83	23032.47	23019.08
1	23255.44	22266.73	22273.08	22274.48	22270.92	22262.41	22248.95
2	21498.24	21509.07	21515.03	21516.11	21512.30	21503.57	21490.00
3	20750.71	20761.08	20766.63	20767.36	20763.26	20754.32	20740.54

v=	J= 7	J= 8	J= 9	J= 10	J= 11	J= 12	J= 13
0	23000.66	22977.21	22948.74	22915.25	22876.75	22833.25	22784.76
1	22230.52	22207.12	22178.80	22145.51	22107.28	22064.12	22016.04
2	21471.50	21448.12	21419.84	21386.67	21348.62	21305.69	21257.90
3	20721.92	20698.45	20670.15	20637.01	20599.03	20556.23	20508.61

v=	J= 14	J= 15	J= 16	J= 17	J= 18	J= 19	J= 20
0	22731.30	22672.88	22609.52	22541.24	22468.07	22390.01	22307.10
1	21963.05	21905.16	21842.40	21774.77	21702.30	21625.00	21542.91
2	21205.26	21147.77	21085.45	21018.33	20946.40	20869.70	20788.24
3	20456.18	20398.96	20336.94	20270.16	20198.61	20122.33	20041.31

v=	J= 21	J= 22	J= 23	J= 24	J= 25	J= 26	J= 27
0	22219.36	22126.83	22029.54	21927.45	21820.68	21709.84	21593.11
1	21456.03	21364.40	21268.04	21166.98	21061.23	20950.72	20835.83
2	20702.04	20611.12	20515.50	20415.22	20310.28	20200.72	20086.56
3	19955.59	19865.18	19770.10	19670.36	19566.00	19457.02	19343.46

v=	J= 28	J= 29	J= 30	J= 31	J= 32	J= 33	J= 34
0	21472.38	21347.05	21217.19	21082.79	20943.91	20800.57	20652.81
1	20716.22	20592.05	20463.34	20330.13	20192.44	20050.31	19903.75
2	19967.82	19844.54	19716.73	19584.42	19447.64	19306.40	19160.75
3	19225.33	19102.66	18975.46	18843.76	18707.58	18566.94	18421.86

v=	J= 35	J= 36	J= 37	J= 38	J= 39	J= 40	J= 41
0	20500.66	20344.15	20183.32	20018.19	19848.80	19675.17	19497.33
1	19752.81	19597.50	19437.86	19273.90	19105.66	18933.16	18756.41
2	19010.69	18856.26	18697.46	18534.90	18366.49	18193.15	18019.13
3	18272.36	18118.46	17960.17	17797.51	17630.49	17459.13	17283.43

94

Table 11i. Line Positions of DF, R-Branch, $\Delta v = 9$ Sequence (Continued,

DF

NU(V,J,+1) , 1/CM , R-BRANCH , DELTA NU = 9

	J= 42	43	44	45	46	47	48
V= 0	19315.30	19129.11	18938.78	18744.32	18545.76	18343.10	18136.35
1	18575.44	18390.27	18200.90	18007.36	17809.65	17607.77	17401.73
2	17838.83	17654.28	17465.48	17272.43	17075.15	16873.62	16667.86
3	17103.41	16919.07	16730.41	16537.44	16340.14	16138.52	15932.56

	J= 49
V= 0	17925.52
1	17191.54
2	16457.84
3	15722.26

Table 11j. Line Positions of DF, R-Branch, $\Delta v = 10$ Sequence

DF

NU(V,J,+1) , 1/CM , R-BRANCH , DELTA NU = 10

J	v=0	v=1	v=2
0	25162.29	24313.50	23476.31
1	25172.98	24323.75	23486.11
2	25178.14	24328.55	23490.52
3	25177.76	24327.88	23489.54
4	25171.84	24321.75	23483.16
5	25160.37	24310.14	23471.37
6	25143.35	24293.07	23454.17
7	25120.78	24270.51	23431.57
8	25092.67	24242.49	23403.56
9	25059.02	24206.01	23370.15
10	25019.84	24170.07	23331.34
11	24975.15	24125.68	23287.14
12	24924.94	24075.85	23237.57
13	24869.25	24020.59	23182.62
14	24808.07	23959.92	23122.32
15	24741.43	23893.85	23056.67
16	24669.36	23822.41	22985.69
17	24591.87	23745.61	22909.41
18	24508.98	23663.46	22827.83
19	24440.72	23576.31	22740.98
20	24327.14	23483.25	22648.88
21	24228.19	23385.24	22551.55
22	24123.98	23281.98	22449.01
23	24014.52	23173.50	22341.30
24	23899.83	23059.84	22228.42
25	23779.94	22941.02	22110.41
26	23654.90	22817.08	21987.30
27	23524.73	22688.03	21859.11
28	23389.47	22553.93	21725.87
29	23249.15	22414.70	21587.60
30	23103.82	22270.63	21444.53
31	22953.50	22121.51	21296.09
32	22798.23	21967.45	21142.91
33	22638.04	21808.48	20984.81
34	22472.98	21644.63	20821.81
35	22303.08	21475.92	20653.95
36	22128.97	21302.40	20481.24
37	21948.87	21124.08	20303.71
38	21764.64	20940.99	20121.38
39	21575.69	20753.16	19934.26
40	21382.06	20560.61	19742.38
41	21183.77	20363.36	19545.76
42	20980.84	20161.44	19344.39
43	20773.31	19954.85	19136.30
44	20561.61	19743.61	18927.48
45	20344.74	19527.45	18711.96
46	20123.25	19306.73	18491.72
47	19897.46	19082.10	18266.77
48	19667.13	18852.35	18037.09
49	19432.27	18617.97	17802.58

96

Table 11k.   Line Positions of DF, R-Branch, $\Delta v = 11$ Sequence

NU(V,J,+1) , 1/CM , R-BRANCH , DELTA NU = 11

CF	1	2	3	4	5	6
J= 0	1	2	3	4	5	6
v=0: 27220.35	27230.01	27233.62	27231.17	27222.66	27208.09	27187.46
v=1: 26291.57	26300.79	26304.05	26301.32	26292.61	26277.92	26257.24
J= 7	A	9	10	11	12	13
v=0: 27160.77	27128.03	27089.23	27044.40	26993.54	26936.72	26873.79
v=1: 26230.58	26197.94	26159.32	26114.74	26064.20	26009.92	25945.31
J= 14	15	16	17	18	19	20
v=0: 26804.94	26730.12	26649.37	26562.70	26470.14	26374.72	26267.46
v=1: 25876.98	25802.75	25722.65	25636.69	25544.89	25447.29	25343.90
J= 21	22	23	24	25	26	27
v=0: 26157.39	26041.56	25919.98	25792.69	25659.73	25521.13	25376.94
v=1: 25234.75	25119.87	24999.29	24873.04	24741.15	24603.66	24460.58
J= 28	29	30	31	32	33	34
v=0: 25227.18	25071.89	24911.11	24744.88	24573.24	24396.22	24213.86
v=1: 24311.97	24157.84	23998.24	23833.19	23662.73	23486.88	23305.69
J= 35	36	37	38	39	40	41
v=0: 24018.18	23833.26	23635.10	23431.73	23223.19	23009.51	22790.72
v=1: 23119.18	22927.38	22730.33	22528.03	22320.53	22107.85	21889.96
J= 42	43	44	45	46	47	48
v=0: 22566.84	22337.89	22103.90	21864.88	21620.84	21371.79	21117.75
v=1: 21666.99	21438.87	21205.62	20967.26	20723.80	20475.24	20221.58
J= 49						
v=0: 20858.71						
v=1: 19962.81						

Table 111. Line Positions of DF, R-Branch, $\Delta v = 1?$ Sequence

NU(V,J,+1) , 1/CM , R-BRANCH , DELTA NU = 12

DF	0	1	2	3	4	5	6
J=	0	1	2	3	4	5	6
V= 0	29198.42	29207.05	29209.11	29204.61	29193.53	29175.87	29151.64
J=	7	8	9	10	11	12	13
V= 0	29120.84	29083.47	29039.55	28989.08	28932.07	28868.54	28798.51
J=	14	15	16	17	18	19	20
V= 0	28722.00	28639.02	28549.61	28453.79	28351.57	28243.00	28128.10
J=	21	22	23	24	25	26	27
V= 0	28006.91	27879.45	27745.77	27605.89	27459.86	27307.71	27149.49
J=	28	29	30	31	32	33	34
V= 0	26985.22	26814.95	26638.71	26456.55	26268.51	26074.62	25874.92
J=	35	36	37	38	39	40	41
V= 0	25669.46	25458.25	25241.34	25018.77	24790.56	24556.74	24317.35
J=	42	43	44	45	46	47	48
V= 0	24072.39	23821.91	23565.91	23304.40	23037.41	22764.93	22486.98
J=	49						
V= 0	22203.54						

Table 12a.　Comparison of Observed and Calculated Line Positions of HF, $\Delta v = 1$ Sequence[a]

J	P(J) [b]	Δ(obs.-calc.)	R(J) [b]	Δ(obs.-calc.)
		$1 \to 0$ band ($v_o - 3961.60$ cm^{-1}) obs. (v_o 3961.58 cm^{-1}) calc.		
5	3741.66	+.06		
6	3693.64	+.10		
7	3644.24	+.02	4230.85	-.02
8	3593.89	+.08	4256.32	-.10
9	3542.21	-.04	4279.91	-.14
10	3489.67	.03	4301.55	-.16
11	3436.08	+.04	4321.28	-.10
12	3381.45	-.05	4339.15	-.12
13	3326.00	-.08	4354.66	+.03
14	3269.85	.02	4368.12	-.05
15	3212.88	.05	4379.67	+.06
16			4389.01	+.07
17			4396.12	-.02
18			4401.21	-.01
19			4404.10	0.00
20			4404.87	-.04
21			4403.45	.07
22			4399.89	.14
23			4394.20	.27
24			4386.37	.46
25			4376.28	.60
26			4363.78	.52
27			4349.57	.95

Table 12a. Comparison of Observed and Calculated Line Positions of HF, $\Delta v = 1$ Sequence[a] (Continued)

J	P(J) [b]	Δ(obs. -calc.)	R(J) [b]	Δ(obs. -calc)
		$2 \to 1$ band ($v_0 = 3789.42$ cm^{-1}) obs. ($v_0 = 3789.41$ cm^{-1}) calc.		
0			3827.49	.02
1	3749.91	.07	3863 97	-.01
2	3708.88	.06	3898.90	.01
3	3666.42	.02	3932.16	.01
4	3622.58	-.04	3963.70	-.03
5	3577.52	-.02	3993.55	-.02
6	3531.20	-.01	4021.70	.06
7	3483.71	-.02	4047.98	-.07
8	3435.10	-.06	4072.24	-.08
9	3385.23	-.07	4094.85	-.01
10	3334.48	-.05	4115.38	.11
11	3282.76	.04	4134.14	-.03
12	3229.97	-.18	4150.84	-.04
13			4165.50	-.09
14			4178.21	-.07
15			4188.86	-.06
16			4197.50	.00
18			4208.42	.02
19			4210.68	-.01
20			4210.81	-.04
21			4209.05	.18
22			4205.05	.30
23			4198.93	.46
24			4190.41	.38

Table 12a. Comparison of Observed and Calculated Line Positions of HF, $\Delta v = 1$ Sequence[a] (Continued)

J	P(J)[b]	Δ(obs.-calc.)	R(J)[b]	Δ(obs.-calc.)
		$3 \rightarrow 2$ band ($v_0 = 3622.02$ cm^{-1}) obs.		
		($v_0 = 3222.00$ cm^{-1}) calc.		
0			3658.59	0.00
1	3583.95		3693.64	-.03
2	3544.48		3727.25	.06
3	3503.68		3759.13	.03
4	3461.54			
5	3411.99		3817.94	-.01
6	3373.32		3844.87	.08
7	3327.49		3869.85	-.03
8	3280.63		3893.15	-.01
9	3232.51		3914.61	.01
10			3934.46	.09
11			3951.84	-.01
12			3967.60	.01
13			3981.40	.01
14			3993.23	.03
15			4003.11	.10
16			4010.90	.10
17			4016.63	.11
18			4020.30	.07
21			4019.00	.23
22			4014.47	.40

[a] D.E. Mann et al., J. Chem. Phys. **34**, 420 (1961).
[b] Units in cm^{-1}.

Table 12b. Comparison of Observed and Calculated
Line Positions of HF, $\Delta v = 2$ Sequence[a]

J	P(J)[b]	Δ(obs.-calc.)	R(J)[b]	Δ(obs.-calc.)
		$2 \rightarrow 0$ band $(\nu_o = 7750.98$ cm$^{-1})$ obs.		
		$(\nu_o = 7750.99$ cm$^{-1})$ calc.		
1	7709.78	-.10		
2	7666.00	+.23	7855.83	-.01
3	7618.57	-.14	7884.33	-.14
4	7568.66	-.10	7909.99	+.12
5	7515.94	-.04	7932.01	+.00
6	7460.39	-.03	7950.91	+.05
7	7402.02	-.12	7966.33	-.04
8	7341.34	+.09	7978.39	-.15
9	7277.96	-.20	7987.09	-.23
10	7211.70	-.06	7992.58	-.13
11	7143.14	-.18	7994.55	-.14
12	7072.57	+.07	7992.94	-.29
13	6999.31	-.07	7988.07	-.27
14	6923.91	-.13	7979.86	-.13
15	6846.57	+.04	7968.13	-.07
16	6766.93	+.01	7953.11	+.16
17	6685.36	+.01	7934.37	+.12
18	6601.75	-.06	7912.34	+.24
19	6516.35	-.06	7886.49	-.01
20	6429.23	-.01	7857.68	+.21
21	6340.41	+.07	7825.14	.12
22	6249.84	+.04	7789.66	+.51
23	6157.64	-.05	7750.66	+.78
24	6063.94	-.14	7707.79	+.56
25	5968.88	-.17	7662.46	+1.25
26	5872.65	-.01	7613.10	+1.25
27	5775.10	+.12		
28	5676.05	-.03		

Table 12b.   Comparison of Observed and Calculated
Line Positions of HF, $\Delta v = 2$ Sequence[a]
(Continued)

J	P(J)[b]	Δ(obs.-calc.)	R(J)[b]	Δ(obs.-calc.)
		$3 \to 1$ band $(\nu_o = 7411.45$ cm$^{-1})$ obs.		
		$(\nu_o = 7411.41$ cm$^{-1})$ calc.		
0			7448.01	+.01
1	7372.07	+.23	7481.66	+.08
2	7329.42	+.07	7512.10	-.01
3	7284.00	-.01	7539.56	+.07
4	7235.95	+.13	7563.69	-.06
5	7185.01	+.13	7584.88	-.05
6	7131.19	-.05	7602.94	+.25
7	7074.99	+.04	7617.58	+.27
8	7016.04	-.05	7629.01	+.35
9	6954.62	-.09	7636.95	+.23
10	6890.84	-.03	7641.62	+.17
11	6824.52	-.13	7643.23	+.38
12	6756.26	-.15	7641.06	+.16
13	6685.81	+.49	7635.78	+.19
14	6612.16	-.18	627 26	+.36
15	6537.41	-.15	7 15.13	+.29
16	6460.41	-.29	7519.59	+.20
17	6380.92	-.10	7580.46	-.09
18	6299.89	-.12	7558.27	-.07
19	6216.79	-.37	7532.93	+.19
20	6132.37	-.18	7504.11	+.35
21	6046.16	-.08	7471.88	+.47
22	5958.34	+.03	7436.12	+.42
23	5868.88	+.66	7397.21	+.57
24	5773.03	+.20	73.5.32	+1.08
25	5685.59	+.17	7309.61	+1.10

Table 12b. Comparison of Observed and Calculated Line Positions of HF, $\Delta v = 2$ Sequence[a] (Continued)

J	$P(J)$[b]	Δ(obs.-calc.)	$R(J)$[b]	Δ(obs.-calc.)
		$4 \rightarrow 2$ band (ν_o = 7080.85 cm^{-1}) obs.		
		(ν_o = 7080.83 cm^{-1}) calc.		
0			7115.97	-.02
1	7042.61	-.16	7148.12	-.07
2	7001.90	+.05	7177.35	-.06
3	6958.18	+.05	7203.60	+.01
4	6911.54	-.11	7226.89	+.18
5	6862.73	-.23	7246.99	+.28
6	6810.56	-.11	7263.79	+.22
7	6756.26	-.02	7277.43	+ 17
8	6699.37	+.01	7287.77	+.02
9	6640.08	+.11	7295.08	+.06
10	6578.39	+.20	7299.06	+.02
11	6514.05	-.02	7299.74	-.06
12	6447.87	+.20	7297.33	+.03
13	6379.05	-.02	7291.53	+.08
14	6308.17	-.15	7282.38	+.06
15	6235.41	-.08	7270.17	+.30
16	6160.74	+.09	7254.34	+.24
17	6083.99	+.13	7235.26	+.26
18	6005.34	+.14	7212.84	+.27
19	5924.78	+.06	7187.27	+.46
20	5842.83	+.35	7158.00	+.28
21	5758.72	+.15	7125.95	+.64
22	5673.17	+.13	7090.43	+.86
23			7051.31	+.80
24			7009.41	+1.26

Table 12b. Comparison of Observed and Calculated Line Positions of HF, $\Delta v = 2$ Sequence[a] (Continued)

J	P(J)[b]	Δ(obs.-calc.)	R(J)[b]	Δ(obs.-calc.)
		$5 \to 3$ band ($\nu_o = 6758.22$ cm^{-1}) obs.		
		($\nu_o = 6758.14$ cm^{-1}) calc.		
0			6791.95	+.06
1	6721.59	+.04	6822.61	-.14
2	6682.27	-.11	6850.86	+.17
3	6640.19	+.17	6875.78	+.13
4	6595.14	-.05	6897.65	+.05
5	6547.96	+.25		
6	6497.70	+.06	6932.18	-.15
7	6445.24	+.19	6945.12	+.07
8	6389.97	+.00		
9	6332.51	+.03	6961.22	+.16
10	6272.75	+.12	6964.38	+.11
11	6210.50	+.02	6964.38	+.06
12	6145.96	-.13	6961.22	+.10
13	6079.74	+.21		
14	6011.17	+.32	6945.12	+.13
15	5940.23	+.10	6932.29	+.25
16	5867.55	+.14	6915.99	+.18
17	5792.94	+.17	6896.70	+.40
18	5716.45	+.18	6874.06	+.56
19			6847.98	+.57
20			6818.48	+.45

Table 12b. Comparison of Observed and Calculated Line Positions of HГ, $\Delta v = 2$ Sequence[a] (Continued)

$6 \rightarrow 4$ band ($\nu_o = 6442.10$ cm^{-1}) obs.

($\nu_o = 6442.10$ cm^{-1}) calc.

J	P(J)[b]	Δ(obs.-calc.)	R(J)[b]	Δ(obs.-calc.)
0			6774.59	+.12
1	6406.89	-.05	6503.95	-.04
2	6369.07	+.03	6530.76	+.12
3	6328.33	-.10	6554.60	+.23
4	6285.18	+.00	6575.34	+.19
5	6239.30	-.02	6592.99	+.06
6	6190.92	+.00	6607.63	-.06
7	6139.78	-.25	6619.39	+.00
8	6086.85	-.15	6628.09	+.09
9	6031.23	+.24	6633.68	+.18
10	5972.91	-.04	6635.39	+.22
11	591?.82	+.17	6636.09	+.32
12	5850.44	+.30	6631.32	+.22
13	5785.79	+.32	6624.07	-.14
14	5718.85	+.13	6613.76	+.20
15			6600.33	+.38
16			6583.66	+.55
17			6563.77	+.74
18			6540.51	+.82

[a] D. E. Mann et al., J. Chem. Phys. 34, 420 (1961).

[b] Units in cm^{-1}.

Table 12c.   Comparison of Observed and Calculated
Line Positions of ^7F, $\Delta v = 3$ Sequence[a]

J	P(J)[b]	Δ(obs.-calc.)	R(J)[b]	Δ(obs.-calc.)
		$3 \to 0$ band ($v_o = 11372.92$ cm^{-1}) obs.		
		($v_o = 11372.99$ cm^{-1}) calc.		
0			11409.51	-.08
1	11331.81	-.07	11441.59	-.02
2	11286.18	-.12	11468.95	-.08
3	11236.24	-.07	11491.73	-.08
4	11181.94	.02	11509.79	-.10
5	11123.27	-.05	11523.19	-.08
6	11060.44	-.01	11531.82	-.09
7	10993.36	-.06	11535.66	-.12
8	10992.30	.00	11534.82	.06
9	10847.18	-.01	11529.10	-.08
10	10768.09	-.01	11518.63	-.05
11			11503.36	-.01
12	10598.45	-.02	11483.29	.03
13	10508.10	.03	11458.39	-.05
14	10414.07	-.01	11428.66	.04
15	10316.59	.06	11394.16	.05
16	10215.63	.06	11354.95	.11
17	10111.34	.08	11310.95	.15
18	10003.69	-.01	11262.18	.15
19	9892.97	.00	11208.82	.27
			11150.65	.27
			11087.88	.33

Table 12c. Comparison of Observed and Calculated
Line Positions of HF, $\Delta v = 3$ Sequence[a]
(Continued)

J	P(J) [b]	Δ(obs.-calc.)	R(J) [b]	Δ(obs.-calc.)
	4→1 band (v_o=10870.37 cm^{-1}) obs. (v_o=10870.24 cm^{-1}) calc.			
0			10905.50	.10
1	10830.82	.15		
2	10786.88	.13	10962.44	.13
3	10738.63	.11	10984.11	.13
4	10686.14	.10	11001.21	.13
5	10629.48	.11	11013.71	.13
6	10568.68	.11	11021.58	.11
7	10503.82	.11	11024.81	.11
8	10434.92	.06	11023.35	.11
9	10362.17	.08	11017.23	.09
10	10285.57	.10	11006.40	.08
11	10205.17	.10	10990.91	.11
12	10121.08	.10	10970.69	.11
13	10033.33	.06	10945.75	.10
14	9942.03	.01	10916.18	.16

Table 12c. Comparison of Observed and Calculated Line Positions of HF, $\Delta v = 3$ Sequence[a] (Continued)

J	P(J) [b]	Δ (obs.-calc.)	R(J) [b]	Δ (obs-calc.)
		$5 \to 2$ band ($\nu_o = 10380.29$ cm^{-1}) obs.		
		($\nu_o = 10380.14$ cm^{-1}) calc.		
0			10414.07	.18
1	10342.17	.09	10443.43	.15
2	10299.94	.19	10468.45	.17
3	10253.41	.19	10488.98	.14
4	10202.68	.16	10505.17	.23
5	10147.91	.18	10516.68	.15
6	10089.07	.17	10523.74	.15
7	10026.20	.10	10526.25	.15
8	9959.45	.07	10524.20	.16
9			10517.55	.15
10			10506.31	.16
11			10490.46	.17
12			10470.02	.21
13			10444.90	.19
14			10415.24	.24
15			10380.98	.32
16			10342.17	.45
17			10298.69	.51
18			10250.65	.60
19			10198.07	.71
20			10140.82	.75

Table 12c. Comparison of Observed and Calculated Line Positions of HF, $\Delta v = 3$ Sequence[a] (Continued)

J	P(J) [b]	Δ(obs.-calc.)	R(J) [b]	Δ(obs.-calc.)
		$6 \to 3$ band (calc $\nu_o = 9900.93$ cm^{-1})		
1			9961.49	.10
2			9985.21	.04
3			10004.62	.02
4			10019.75	.11
5			10030.35	.08
6			10036.57	.12
7			10038.31	.15
8			10035.54	.16
9			10028.28	.18
10			10016.49	.20
11			10000.19	.25
12			9979.33	.28
13			9953.95	.34

[a] D. E. Mann et al., J. Chem. Phys. 34, 420 (1961).
[b] In units cm^{-1}.

Table 12d.   Comparison of Observed and Calculated
Line Positions of HF, $\Delta v = 4$ Sequence[a]

J	P(J)[b]	Δ(obs.-calc.)	R(J)[b]	Δ(obs.-calc.)
		$4 \to 0$ band ($\nu_0 = 14831.75$ cm^{-1}) obs. ($\nu_0 = 14831.82$ cm^{-1}) calc.		
0			14866.92	-.06
1	14790.63	-.08	14896.08	-.06
2	14743.60	-.09	14919.19	-.07
3	14690.77	-.06	14936.22	-.08
4	14632.12	-.06	14947.14	-.09
5	14567.75	-.06	14951.94	-.09
6	14497.72	-.06	14950.62	-.06
7	14422.12	-.06	14943.11	-.06
8	14341.00	-.08	14929.42	-.05
9	14254.50	-.05	14909.57	-.03
10	14162.65	-.05	14883.54	-.01
11	14065.56	-.03	14851.33	.01
12	13963.28	-.05	14812.96	.03
13	13856.00	-.02	14768.41	.01
14	13743.74	.00	14717.73	-.01
15	13626.61	.02	14661.06	.09
16	13504.71	-.02	14598.29	.15
17	13378.16	.04	14529.47	.21
18	13247.08	.08	14454.60	.23
19	13111.48	.05	14373.87	.35
20			14287.25	.50
21			14194.67	.58

Table 12d. Comparison of Observed and Calculated
Line Positions of HF, Δv = 4 Sequence[a]
(Continued)

J	P(J) [b]	Δ(obs.-calc.)	R(J) [b]	Δ(obs.-calc.)
		5 → 1 band (ν_o = 14169.64 cm^{-1}) obs.		
		(ν_o = 14169.55 cm^{-1}) calc.		
0			14203.36	.06
1	14130.06	.08	14231.26	.07
2	14084.72	.07	14253.26	.08
3	14033.68	.07	14269.32	.09
4	13977.01	.10	14279.40	.08
5	13914.70	.08	14283.50	.09
6	13846.92	.12	14281.58	.09
7	13773.62	.09	14273.62	.08
8	13694.98	.10	14259.63	.08
9	13611.01	.08	14239.58	.07
10	13521.83	.07	14213.48	.06
11	13427.52	.07	14181.38	.09
12	13328.13	.05	14143.22	.10
13	13223.84	.08	14099.06	.15
14	13114.61	.05	14048.89	.19
15	13000.68	.10		
16	12882.08	.16	13930.63	.31
17	12758.88	.21	13862.61	.42
18	12631.18	.25	13788.69	.53
19	12499.07	.27	13708.88	.64
20	12362.75	.38	13623.26	.78
21	12222.22	.47	13531.86	.96
22	12077.60	.57		
23			13331.91	1.44

Table 12d. Comparison of Observed and Calculated Line Positions of HF, $\Delta v = 4$ Sequence[a] (Continued)

J	P(J) [b]	Δ(obs.-calc.)	R(J) [b]	Δ(obs.-calc.)
		6→2 band (ν_0 =13523.02 cm^{-1}) obs.		
		(ν_0 =13522.93 cm^{-1}) calc.		
0			13555.38	.09
1	13484.93	.06	13582.02	.10
2	13441.29	.13	13602.88	.12
3	13391.95	.10	13617.94	.15
4	13337.09	.08	13627.12	.14
5	13276.78	.10	13630.41	.12
6	13211.04	.13	13627.84	.13
7	13139.96	.10	13619.36	.15
8	13063.60	.11	13604.94	.15
9	12982.04	.12	13584.61	.17
10	12895.36	.13	13558.34	.20
11	12803.66	.18	13526.14	.23
12	12706.96	.19	13488.02	.28
13	12605.40	.22	13444.00	.36
14	12499.06	.28	13394.00	.38
15	12388.00	.32	13338.14	.44
16	12272.30	.35		
17	12152.09	.40	13208.86	.65
18	12027.45	.46	13135.42	.73
19	11898.47	.54	13056.29	.93
20	11765.24	.63	12971.30	1.03
21			12880.63	1.27

Table 12d. Comparison of Observed and Calculated Line Positions of HF, $\Delta v = 4$ Sequence[a] (Continued)

J	P(J) [b]	Δ(obs.-calc.)	R(J) [b]	Δ(obs.-calc.)
		$7 \rightarrow 3$ band $(v_0 = 12889.53$ cm$^{-1})$ obs. $(v_0 = 12889.46$ cm$^{-1})$ calc.		
0			12920.48	.02
1			12945.89	.08
2	12810.81	.09	12965.60	.11
3	12763.20	.12	12979.56	.10
4	12710.11	.12	12987.79	.11
5	12651.64	.12	12990.26	.14
6	12587.85	.13	12986.95	.18
7	12518.84	.18	12977.82	.21
8	12444.61	.20	12962.85	.24
9	12365.22	.19	12942.05	.28
10	12280.85	.25	12915.39	.31
11	12191.48	.29	12882.91	.37
12	12097.21	.33	12844.60	.46
13	11998.15	.40	12800.40	.51
14	11894.32	.45	12750.37	.57
15	11785.81	.49	12694.48	.61
16	11672.69	.45	12632.79	.68
17			12565.32	.78
18			12492.05	.77
19			12413.02	.97

Table 12d. Comparison of Observed and Calculated Line Positions of HF, $\Delta v = 4$ Sequence[a] (Continued)

J	P(J)[b]	Δ(obs.-calc.)	R(J)[b]	Δ(obs.-calc.)

8 → 4 band $(v_o = 12266.46$ cm$^{-1})$ obs.
$(v_o = 12266.36$ cm$^{-1})$ calc.

J	P(J)[b]	Δ(obs.-calc.)	R(J)[b]	Δ(obs.-calc.)
1			12320.17	.08
2	12190.67	.09		
3	12144.63	.11	12351.55	.14
4	12093.24	.14	12358.73	.14
5	12036.52	.16	12360.25	.17
6	11974.56	.18	12356.05	.21
7	11907.37	.19		
8	11835.12	.26	12330.39	.25
9	11757.72	.25	12308.89	.26
10	11675.37	.28	12281.72	.38
11	11588.07	.29	12248.67	.41
12			12209.85	.46
13			12165.18	.46
14			12114.74	.48
15			12058.45	.45
16			11996.37	.41

9 → 5 band $(v_o = 11650.72$ cm$^{-1})$ obs.
$(v_o = 11650.58$ cm$^{-1})$ calc.

J	P(J)[b]	Δ(obs.-calc.)	R(J)[b]	Δ(obs.-calc.)
3			11731.11	.54
4			11737.53	.90
6			11734.03	2.23
7			11724.06	3.30
8			11708.61	4.39
9			11687.75	5.90

[a] D. E. Mann et al., J. Chem. Phys. 34, 420 (1961).
[b] In units of cm^{-1}.

Table 12e.   Comparison of Observed and Calculated Line Position of HF, $\Delta v = 5$ Sequence[a]

J	P(J) [b]	Δ(obs.-calc.)	R(J) [b]	Δ(obs.-calc.)
		$5 \rightarrow 0$ band ($\nu_o = 18131.10$ cm^{-1}) obs.		
		($\nu_o = 18131.13$ cm^{-1}) calc.		
1			18191.17	-.06
2				
3				
4	17923.09	.04	18225.37	-.09
5	17853.10	.04		
6	17776.05	.04		
7	17692.02	.02	18192.02	-.01
8	17601.10	.00	18165.72	-.04
9	17503.37	-.03	18131.90	-.07
10			18090.75	
11				
12	17170.41	-.03		
13	17046.51	.00	17921.89	.23
14	16916.31	-.03		

Table 12e.   Comparison of Observed and Calculated
Line Position of HF, $\Delta v = 5$ Sequence[a]
(Continued)

J	P(J)[b]	Δ(obs.-calc.)	R(J)[b]	Δ(obs.-calc.)

6 → 1 band   ($\nu_0 = 17312.42$ cm^{-1}) obs.
($\nu_0 = 17312.34$ cm^{-1}) calc.

J	P(J)[b]	Δ(obs.-calc.)	R(J)[b]	Δ(obs.-calc.)
1			17370.01	.19
2	172. .07	-.02	17387.82	.16
3	17172.22	.02	17398.35	.17
4	17111.40	-.01	17401.51	.15
5	17043.64	.07	17397.36	.19
6	16968.88	-.04	17385.77	.16
7	16887.32	-.02	17366.83	.18
8			17340.49	.19
9	16704.21	.17	17306.76	.21
10	16602.62	.11	17265.54	.12
11	16494.64	.15		
12	16380.29	.21	17161.24	.20
13	16259.62	.24	17098.15	.31
14	16132.70	.21	17027.64	.32
15	15999.82	.31	16949.94	.42
16	15860.91	.37	16865.09	.61

Table 12e. Comparison of Observed and Calculated
Line Position of HF, Δv = 5 Sequence[a]
(Continued)

J	P(J) [b]	Δ(obs.-calc.)	R(J) [b]	Δ(obs.-calc.)
	7→2 Band $(\nu_0=16511.60$ cm$^{-1})$ obs.			
	$(\nu_0=16511.46$ cm$^{-1})$ calc.			
2	16428.46	.14	16583.25	.16
3	16376.39	.11	16592.80	.24
4	16317.46	.13	16595.22	.20
5	16251.72	.18	16590.32	.17
6	16179.14	.16	16578.23	.20
7	16099.87	.16	16558.87	.21
8	16014.04	.22	16532.23	.21
9	15921.59	.22	16498.39	.28
10	15822.70	.25	16457.23	.29
11	15717.42	.26	16408.84	.34
12	15605.96	.39	16353.23	.40
13	15488.17	.40	16290.40	.48
14	15364.28	.41	16220.29	.49
15	15234.48	.52	16143.16	.67
16	15098.61	.48	16058.77	.75
17	14957.10	.61	15967.21	.74
18	14809.71	.59	15868.55	.81

Table 12e.   Comparison of Observed and Calculated
Line Position of HF, Δv = 5 Sequence[a]
(Continued)

J	P(J) [b]	Δ(obs.-calc.)	R(J) [b]	Δ(obs.-calc.)

$8 \rightarrow 3$ band (ν_o = 15725.33 cm^{-1}) obs.

(ν_o = 15725.19 cm^{-1}) calc.

J	P(J) [b]	Δ(obs.-calc.)	R(J) [b]	Δ(obs.-calc.)
0			15754.93	.10
1	15688.82	.22	15777.58	.10
2	15645.29	.19	15793.21	.12
3	15594.94	.20	15801.80	.16
4	15537.82	.23	15803.27	.18
5	15473.89	.19	15797.62	.20
6	15403.30	.17	15784.85	.24
7	15326.16	.20	15764.90	.25
8	15242.59	.35	15737.84	.32
9	15152.34	.27	15703.54	.31
10	15055.81	.30	15662.16	.40
11	14953.06	.41	15613.61	.48
12			15557.84	.50
13			15494.90	.50
14	14607.48	.41	15424.76	.44
15	14480.28	.44	15347.63	.51
16			15263.33	.51
17			15171.85	.41
18			15073.27	.26
20			14855.06	-.03
21			14735.37	-.29

Table 12e. Comparison of Observed and Calculated
Line Position of HF, $\Delta v = 5$ Sequence[a]
(Continued)

J	P(J) [b]	Δ(obs.-calc.)	R(J) [b]	Δ(obs.-calc.)
		$9 \rightarrow 4$ band ($\nu_0 = 14949.94$ cm^{-1} obs.		
		($\nu_0 = 14949.89$ cm^{-1}) calc.		
0			14978.30	.12
1			14999.62	.06
2	14872.74	-.01	15014.13	.14
3	14823.98	-.02	15021.60	.16
4			15021.99	.11
5			15015.36	.08
6	14637.75	-.10	15001.78	.16
7	14562.43	.05	14981.05	.17
8	14480.73	.10		
9			14918.28	.14
10			14876.12	.01
11			14826.94	-.04
14			14636.67	.32
15			14558.94	.55

[a] D. E. Mann et al., J. Chem. Phys. 34, 420 (1961).

[b] In units of cm^{-1}.

Table 13a. Comparison of Observed and Calculated
Line Positions of HF, $\Delta v = 1$ Sequence,
$1 \rightarrow 0$ Band[a]

J	P(J)[b]	Δ(obs.-calc.)	R(J)[b]	Δ(obs.-calc.)
0			4000.99	-.16
1	3920.29	-.18	4038.97	-.16
2	2877.70	-.16	4075.30	-.15
3	3833.65	-.16	4109.95	-.13
4	3788.23	-.14	4142.83	-.16
5	3741.48	-.12	4173.98	-.13
6	3693.41	-.13	4203.30	-.12
7	3644.16	-.10	4230.75	-.12
8	3593.71	-.10	4256.32	-.10
9			4279.96	-.09
10	3489.56	-.08	4301.64	-.07
11	3435.95	-.09	4321.33	-.05
12	3381.42	-.08	4339.00	-.03
13	3326.02	-.06	4354.59	-.04
14	3269.78	-.05	4368.14	-.03
15	3212.78	-.05		

[a]D. U. Webb and K. Narahari Rao, J. Molecular Spectroscopy, 28, 121 (1968).

[b]In units of cm^{-1}.

Table 13b. Comparison of Observed and Calculated Line Positions of HF, $\Delta v = 2$ Sequence, $2 \rightarrow 0$ Band[a]

J	P(J)[b]	Δ(obs.-calc.)	R(J)[b]	Δ(obs.-calc.)
0			7788.87	-.19
1	7709.70	-.18	7823.83	-.19
2	7665.60	-.17	7855.65	-.19
3	7618.52	-.19	7884.29	-.18
4			7909.72	-.15
5	7517.81	-.17	7931.85	-.16
6	7460.27	-.15	7950.72	-.14
7	7402.02	-.14	7966.23	-.14
8			7978.25	-.29
9	7277.64	-.12		

[a]D. U. Webb and K. Narahari Rao, J. Molecular Spectroscopy, **28**, 121 (1968).

[b]In units of cm^{-1}.

Table 14. Comparison of Observed and Calculated
Line Positions of HF, Δv = 1 Sequence[a]

| | 1 → 0 band | | 2 → 1 band | | 3 → 2 band | |
J	P(J)[b]	Δ(obs.-calc.)	P(J)[b]	Δ(obs.-calc.)	P(J)[b]	Δ(obs.-calc.)
2			3708.86	+.04	3544.51	+.05
3			3666.38	-.02	3503.80	+.20
4			3622.71	+.09	3461.54	+.11
5			3577.47	-.07	3418.16	+.17
6	3693.50	-.04	3531.31	+.10	3373.46	+.12
7	3644.16	-.10	3483.63	-.06	3327.73	+.22
8	3593.80	-.01	3435.17	+.13	3280.64	+.06
9	3542.20	-.05	3385.34	+.04		
10	3489.59	-.05	3334.55	+.02		
11	3436.12	+.08	3282.86	+.06		
12	3381.50	+.00	3230.18	+.03		
13	3326.21	+.13	3176.60	+.03		
14	3269.90	+.07	3122.14	-.18		
15	3212.80	-.03	3067.22.	-.04		

[a] T. F. Deutsch, Appl. Phys. Letters <u>10</u>, 234 (1967).

[b] In units of cm^{-1}.

Table 15. Comparison of Observed and Calculated Line Positions of DF, $\Delta v = 1$ Sequence[a]

J	1 → 0 band P(J)[b]	Δ(obs.-calc.)	2 → 1 band P(J)[b]	Δ(obs.-calc.)	3 → 2 band P(J)[b]	Δ(obs.-calc.)	4 → 3 band P(J)[b]	Δ(obs.-calc.)
3			2750.05	-.14	2662.17	-.13		
4			2727.38	-.02	2640.04	-.09		
5			2703.98	-.11	2617.41	-.02	2532.50	+.00
6			2680.28	+.02	2594.23	-.01	2509.86	-.06
7			2655.97	+.03	2570.51	-.05	2486.83	-.04
8			2631.09	-.05	2546.37	-.04		
9			2605.87	+.00	2521.81	.00		
10			2580.16	+.00	2496.61	-.15		
11			2553.97	-.04	2471.34	+.06		
12	2611.10	-.10	2527.47	+.03	2445.29	-.11		
13			2500.32	-.15				
14					2392.46	+.01		
15	2527.06	+.07						
16	2498.02	-.15	2417.27					

[a] T. F. Deutsch, Appl. Phys. Letters, 10, 234 (1967).

[b] In units of cm^{-1}.

Table 16. Comparison of Observed and Calculated
Line Positions of DF, $\Delta v = 1$ Sequence[a]

	1→0 band		2→1 band		3→2 band	
J	P(J)[b]	Δ(obs.-calc.)	P(J)[b]	Δ(obs.-calc.)	P(J)[b]	Δ(obs.-calc.)
1						
2						
3			2750.05	-.14		
4			2727.40	+.00		
5			2703.95	-.14		
6	2767.94	-0.17	2680.25	-.01	2594.24	+.00
7	2743.03	-0.10	2655.97	+.03	2570.50	-.06
8	2717.54	-.012	2631.09	-.05	2546.34	-.07
9	2691.43	-.029	2605.86	-.01	2521.81	+.00
10	2665.25	-0.07	2580.18	+.02	2496.21	+.00
11	2638.38	-0.09	2553.95	-.06	2471.33	-.05
12	2611.10	-0.10				
13	2583.45	+0.07				
14	2555.45	+0.01				
15						

[a] D. J. Spenser, G. C. Denault, and H. H. Takimoto, Atmospheric Gas Absorption DF Laser Wavelengths, TR 0074(4240-10)-7, The Aerospace Corporation (January 1974).

[b] In units of cm^{-1}.

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